No. SEF—21AAE

FORK LIFT TRUCK

FG20N2S, FD20Z2S, FG28N7S, FD28Z7S
FG23N2S, FD23Z2S, FG30N7S, FD30Z7S
FG25N2S, FD25Z2S

SERVICE MANUAL

TCM TOYO UMPANKI CO., LTD.

FOREWORD

TCM now introduces forklift trucks FG20N2S through FD30Z7S designed for better controllability, higher safety and more operator's comfort.

The major modifications of the new models compared to the conventional models FG20N2 through FD30Z7 are:

1. Low noise and low fuel consumption
2. Daily check can be easily performed owing to the adoption of the centralized meter.

This manual explains the structural outline of the above models, especially for service personnel and shop workers. We hope this will be a good companion in your servicing job.

The descriptions and specifications described in this manual are subject to change without notice for improvement.

Jan., 1988

TOYO UMPANKI CO., LTD.

MAIN PARTS TABLE

Parts name \ Truck model		FG20N2S, FG23N2S, FG25N2S	FG28N7S, FG30N7S	FD20Z2S, FD23Z2S, FD25Z2S	FD28Z7S, FD30Z7S
ENGINE	C	221A1–00101 Nissan H20M4GR11	←	222A1–00101 Isuzu C240PKJ	←
	T	221B1–00101 Nissan H20A4GR11	←	↑	←
RADIATOR	C	221A2–10101 Toyo Radiator	←	222A2–10101 Toyo Radiator	←
	T	221B2–10101 Toyo Radiator	←	222B2–10101 Toyo Radiator	←
DRIVE UNIT	C	121A2–50001 Kawasaki Heavy Industry	14752–50001 TCM 475–25	122A2–50001 Kawasaki Heavy Industry	14772–50001 TCM 477–25
	T	121B2–50001 Kawasaki Heavy Industry	120L2–50001 TCM 20L–25	122B2–50001 Kawasaki Heavy Industry	120M2–50001 TCM 20M–25
FRONT AXLE		TCM, Full-floating type	←	←	←
WHEEL BRAKE		222A3–70201 (R) 222A3–70211 (L) NISSHINBO	24453–70201 (R) 24453–70211 (L) AKEBONO BRAKE	222A3–70201 (R) 222A3–70211 (L) NISSHINBO	24453–70201 (R) 24453–70211 (L) AKEBONO BRAKE
MASTER CYLINDER		25595–40302 Chikuma Seisakusho	←	←	←
STEERING GEAR		15594–10301 Nihon Power Steering	14354–10201 Nihon Power Steering	15594–10301 Nihon Power Steering	14354–10201 Nihon Power Steering
POWER CYLINDER		25594–50102 TCM	24454–50202 TCM	25594–50102 TCM	24454–50202 TCM
REAR AXLE		24454–30401 TCM, Elliot type	←	←	←
MAIN PUMP		13077–10201 Kayaba, KRP4–23CSSB	14437–10201 Kayaba, KPR4–30CSSB	13657–10201 Kayaba, KRP4–30ASSS	←
CONTROL VALVE		25597–30201 Kayaba Kogyo, KVS–65N–2–VPF	24457–30201 Kayaba Kogyo, KVS–65N–2–VPF	25597–30201 Kayaba Kogyo, KVS–65N–2–VPF	24457–30201 Kayaba Kogyo, KVS–65N–2–VPF
FLOW REGULATOR		23658–40403 TCM	←	←	←
LIFT CYLINDER		23679–40852 (R) 23679–40602 (L) TCM	24459–40601 (R) 24459–40801 (L) TCM	23679–40852 (R) 23679–40602 (L) TCM	24459–40601 (R) 24459–40801 (L) TCM
TILT CYLINDER		23678–50002 (R) 23678–50102 (L) TCM	24468–50002 (R) 24468–50102 (L) TCM	23678–50002 (R) 23678–50102 (L) TCM	24468–50002 (R) 24468–50102 (L) TCM
MAST		23678–01601 TCM, VM–367	24458–01601 TCM, VM-446	23678–01601 TCM, VM-367	24458–01601 TCM, VM-446

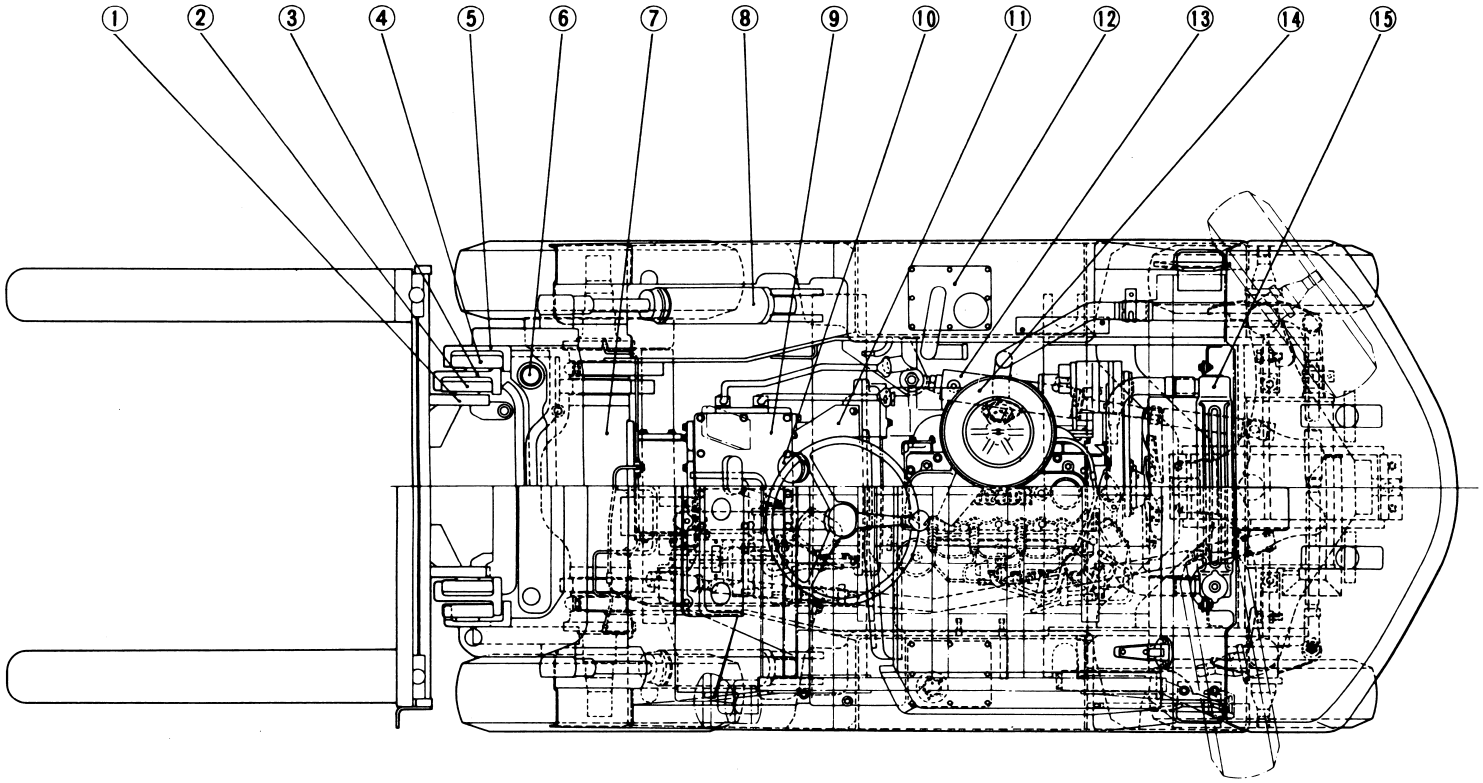


Fig. 1. TOP VIEW (CLUTCH TYPE) REF.

1. Carriage
2. End roller
3. Inner mast
4. End roller
5. Outer mast
6. Lift cylinder
7. Front axle
8. Tilt cylinder
9. Transmission
10. Air filter
11. Clutch
12. Hydraulic fluid reservoir
13. Power cylinder
14. Air cleaner
15. Radiator

1. Load backrest
2. Mast
3. Lift chain
4. Lift cylinder
5. Parking brake lever
6. Head light
7. Combination light
8. Steering handwheel
9. Drivers seat
10. Overhead guard
11. License plate light
12. Radiator
13. Rear combination light
14. Muffler
15. Counterweight
16. Tow pin
17. Rear axle
18. Center arm pin
19. Power cylinder
20. Master cylinder
21. Air filter
22. Clutch
23. Transmission
24. Steering gear
25. Control valve
26. Front axle
27. Carriage
28. Fork

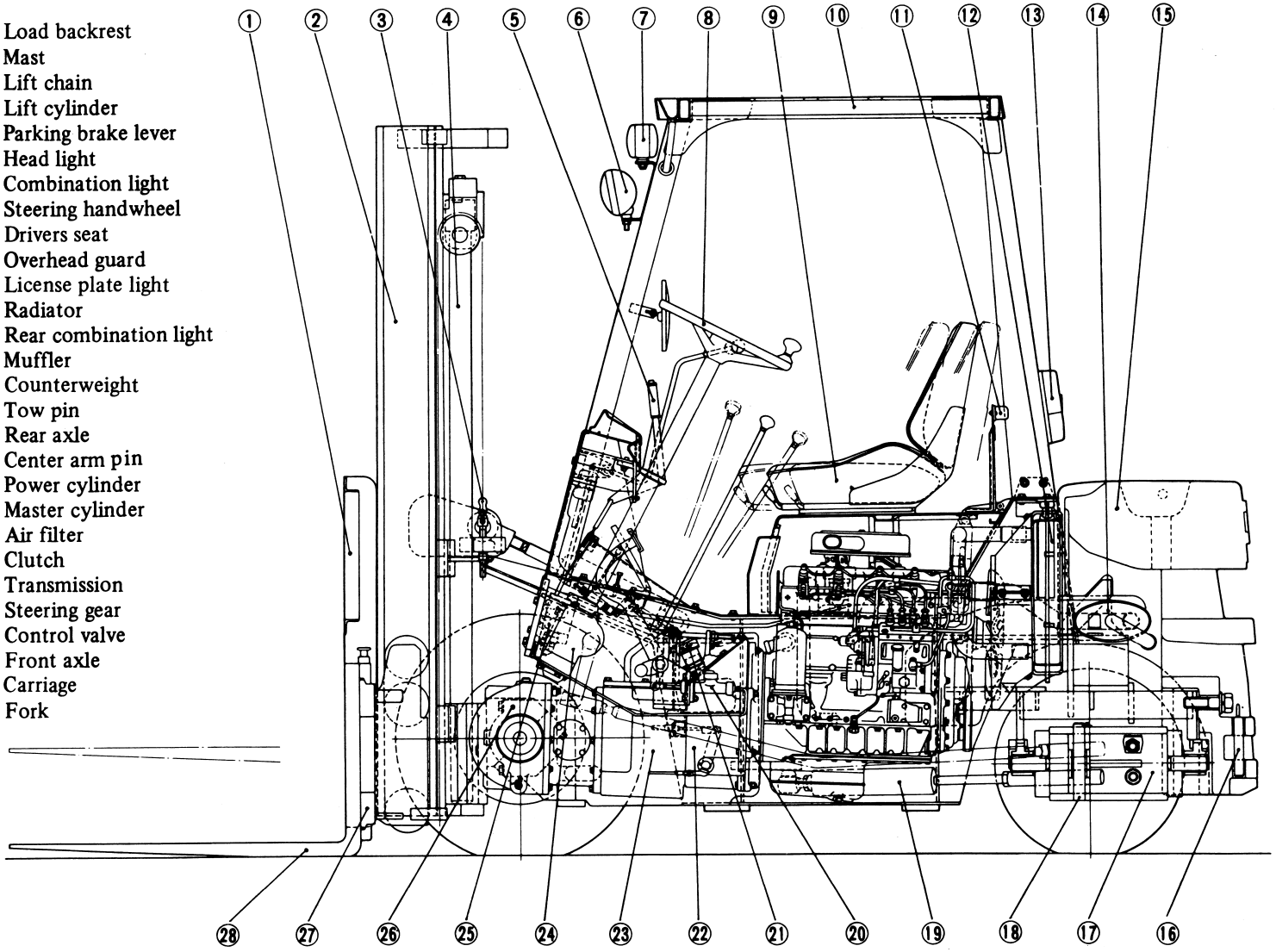
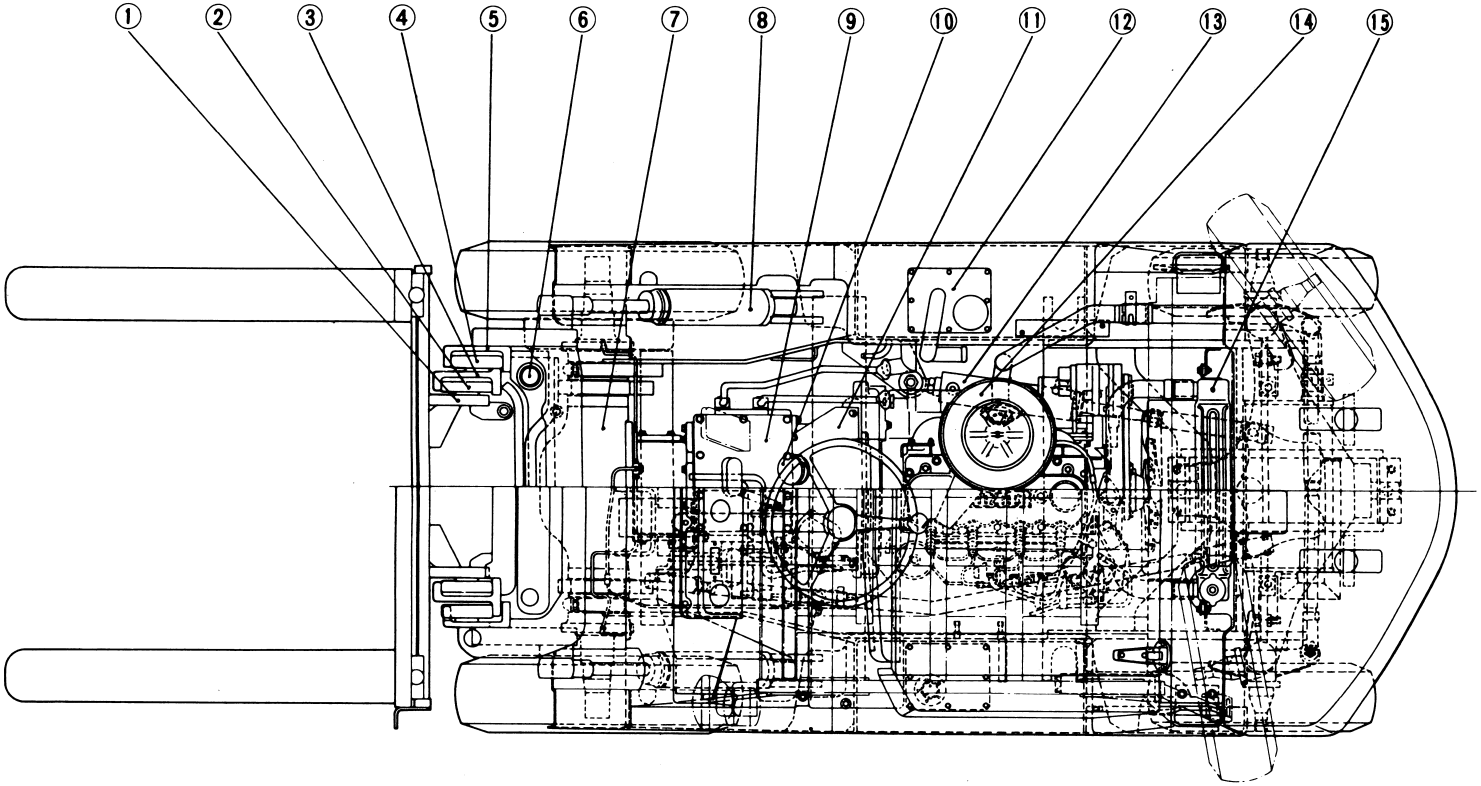


Fig. 2. SIDE VIEW (CLUTCH TYPE) REF.



1. Carriage
2. End roller
3. Inner mast
4. End roller
5. Outer mast
6. Lift cylinder
7. Front axle
8. Tilt cylinder
9. Transmission
10. Air filter
11. Clutch
12. Hydraulic fluid reservoir
13. Power cylinder
14. Air cleaner
15. Radiator

Fig. 3. TOP VIEW (TORQUE CONVERTER TYPE) REF.

1. Load backrest
2. Mast
3. Lift chain
4. Lift cylinder
5. Parking brake lever
6. Head light
7. Combination light
8. Steer handwheel
9. Drivers seat
10. Overhead guard
11. License plate light
12. Radiator
13. Rear combination light
14. Muffler
15. Counterweight
16. Tow pin
17. Rear axle
18. Center arm pin
19. Power cylinder
20. Master cylinder
21. Torque converter
22. Transmission
23. Inching valve
24. Steering gear
25. Control valve
26. Front axle
27. Carriage
28. Fork

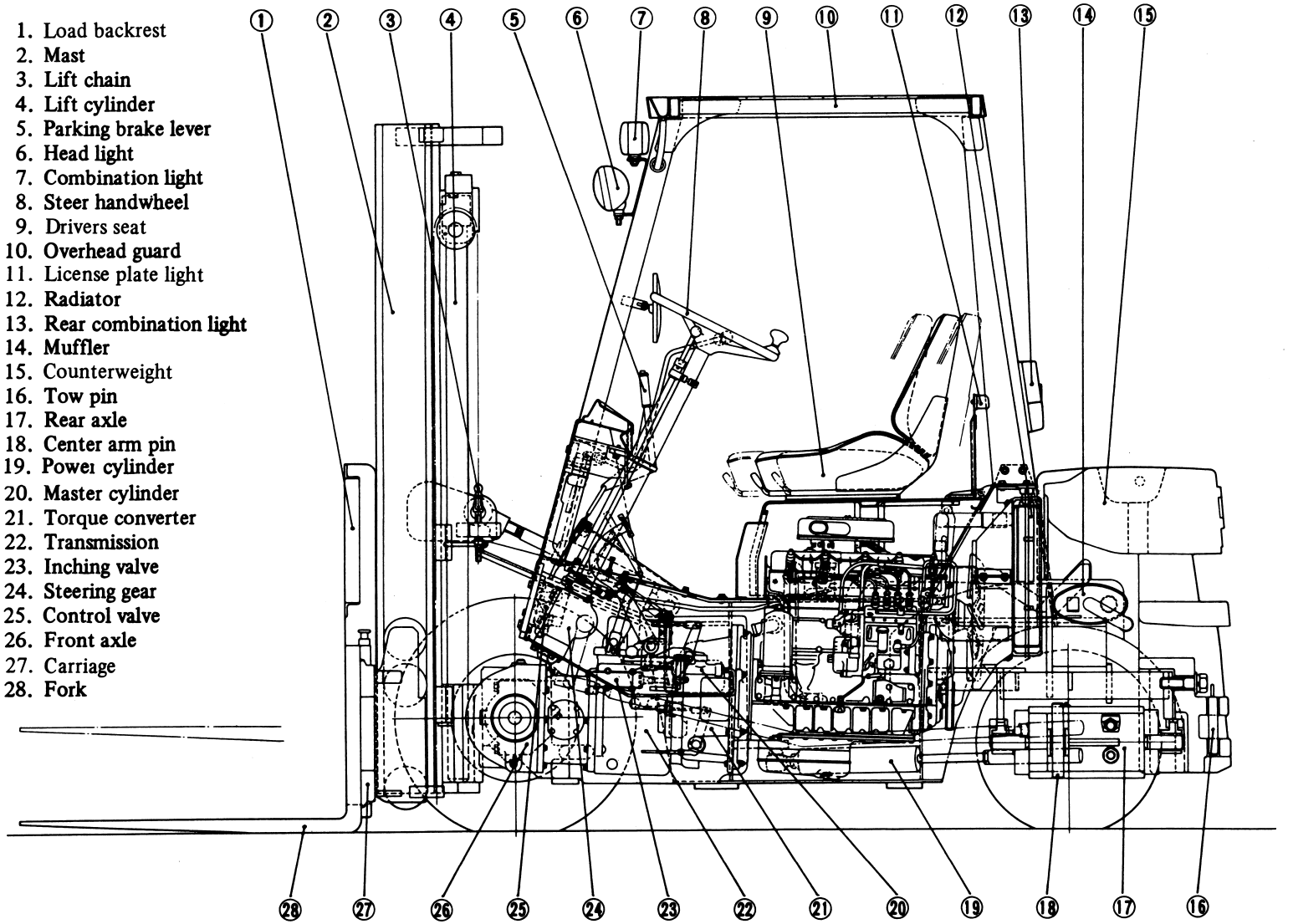


Fig. 4. SIDE VIEW (TORQUE CONVERTER TYPE) REF.

Unit : mm (inch)

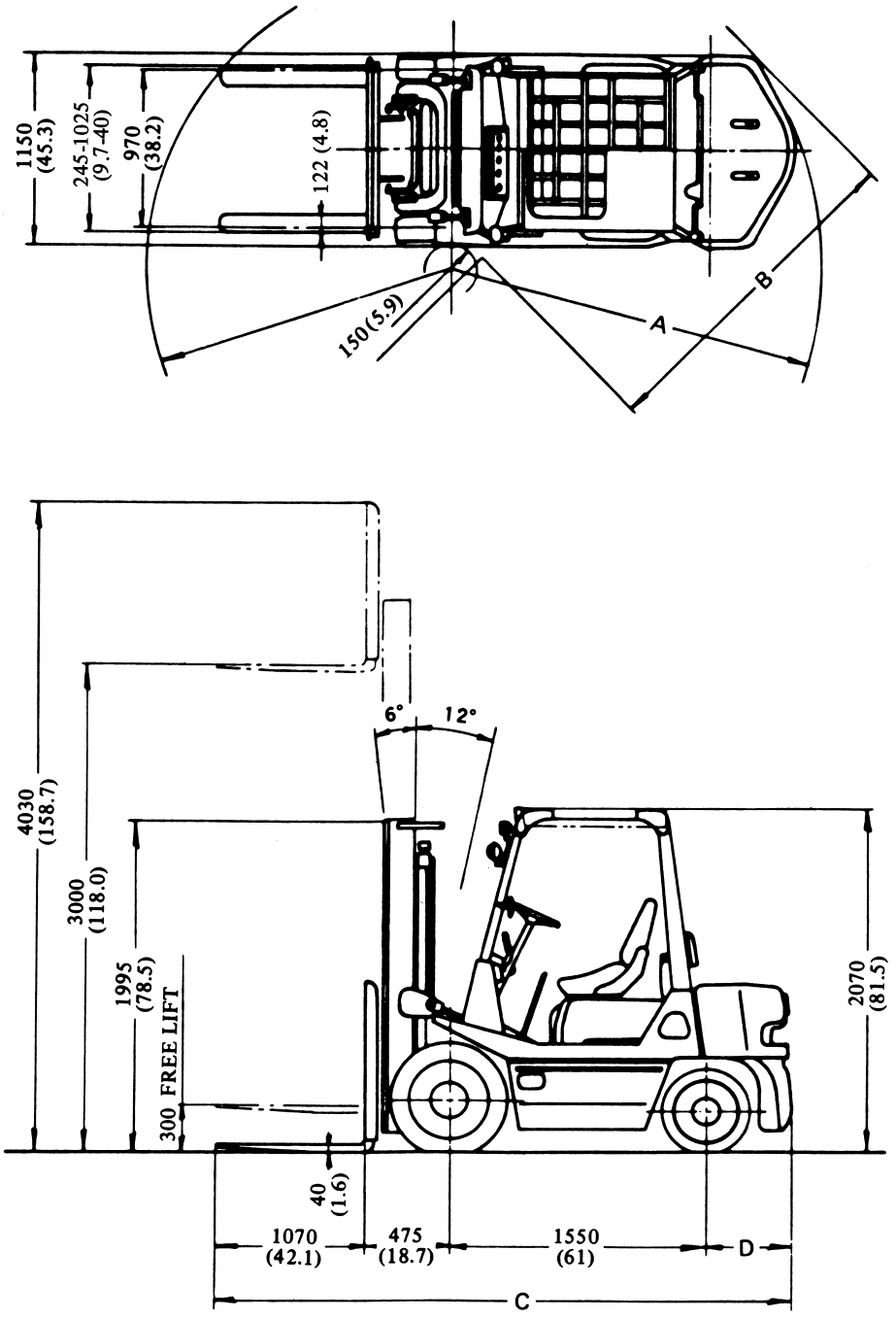


Fig. 5. EXTERNAL VIEW

SPECIFICATIONS

C : Clutch type
T : Tor-con type

	FG20N2S		FG23N2S		FG25N2S		FD20Z2S		FD23Z2S		FD25Z2S	
	C	T	C	T	C	T	C	T	C	T	C	T
PERFORMANCE												
Rated Load kg (lbs)	2000 (4000)		2250 (4500)		2500 (5000)		2000 (4000)		2250 (4500)		2500 (5000)	
Basic Load Center mm (in)	500 (24)		←		←		←		←		←	
Lift Height mm (in)	3000 (118.0)		←		←		←		←		←	
Tilt Angle, fwd/bwd deg.	6/12		←		←		←		←		←	
Free Lift mm (in)	330 (13)		←		←		←		←		←	
Lift Speed;												
unloaded mm/s (fpm)	500 (98.4)		←		←		530 (104.4)		←		←	
loaded mm/s (fpm)	450 (88.6)		←		←		500 (98.4)		←		←	
Travel Speed;												
fwd 1st km/h (mph)	8.5 (5.3)	19.0 (11.8)	←		←		←		←		←	
fwd 2nd km/h (mph)	19.0 (11.8)	–	←		←		←		←		←	
rev 1st km/h (mph)	8.5 (5.3)	19.0 (11.8)	←		←		←		←		←	
rev 2nd km/h (mph)	19.0 (11.8)	–	←		←		←		←		←	
Maximum Drawbar Pull												
unloaded kg (lbs)	850 (1874)		←		←		←		←		←	
loaded kg (lbs)	1100 (2426)	1500 (3308)	←		←		1150 (2536)	1700 (3749)	←		←	
Gradeability												
unloaded	1/4.5		1/5.0		←		1/4.5		1/5.0		←	
loaded	1/5.5	1/4.2	1/6.0	1/4.6	1/6.5	1/5.0	1/5.0	1/3.9	1/5.5	1/4.2	1/6.0	1/4.5
Minimum Turning Radius mm (in) A	2170 (85.4)		2200 (86.6)		2230 (87.8)		2170 (85.4)		2200 (86.6)		2230 (87.8)	
Minimum Intersecting Aisle mm (in) B	1920 (75.6)		1940 (76.4)		2000 (78.7)		1920 (75.6)		1940 (76.4)		2000 (78.7)	
DIMENSIONS												
Overall Length mm (in) C	3410 (134.3)		3440 (135.4)		3620 (142.5)		3410 (134.3)		3440 (135.4)		3620 (134.3)	
Overall Width mm (in)	1150 (45.3)		←		←		←		←		←	
Overall Height mm (in)	2070 (81.5)		←		←		←		←		←	
Overall Height w. extended mast mm (in)	4030 (158.7)		←		←		←		←		←	
Wheelbase mm (in)	1600 (63.0)		←		←		←		←		←	
Tread												
front mm (in)	970 (38.2)		←		←		←		←		←	
rear mm (in)	970 (38.2)		←		←		←		←		←	
Fork Overhang mm (in)	475 (18.7)		←		←		←		←		←	
Rear Overhang mm (in) D	415 (16.3)		445 (17.5)		475 (18.7)		415 (16.3)		445 (17.5)		475 (18.7)	
Fork Size;												
length x width x thickness mm (in)	920 x 122 x 40		←		1070 x 122 x 40		920 x 122 x 40		←		1070 x 122 x 40	
	(36.2 x 4.8 x 1.6)		←		(42.1 x 4.8 x 1.6)		(36.2 x 4.8 x 1.6)		←		(42.1 x 4.8 x 1.6)	
Fork Spacing mm (in)	245-1020 (9.7-40.2)		←		←		←		←		←	
Under Clearance;												
at mast mm (in)	110 (4.3)		←		←		←		←		←	
WEIGHT												
Operating Weight kg (lbs)	3270		3450		3650		3360		3540		3740	

Unit: mm (inch)

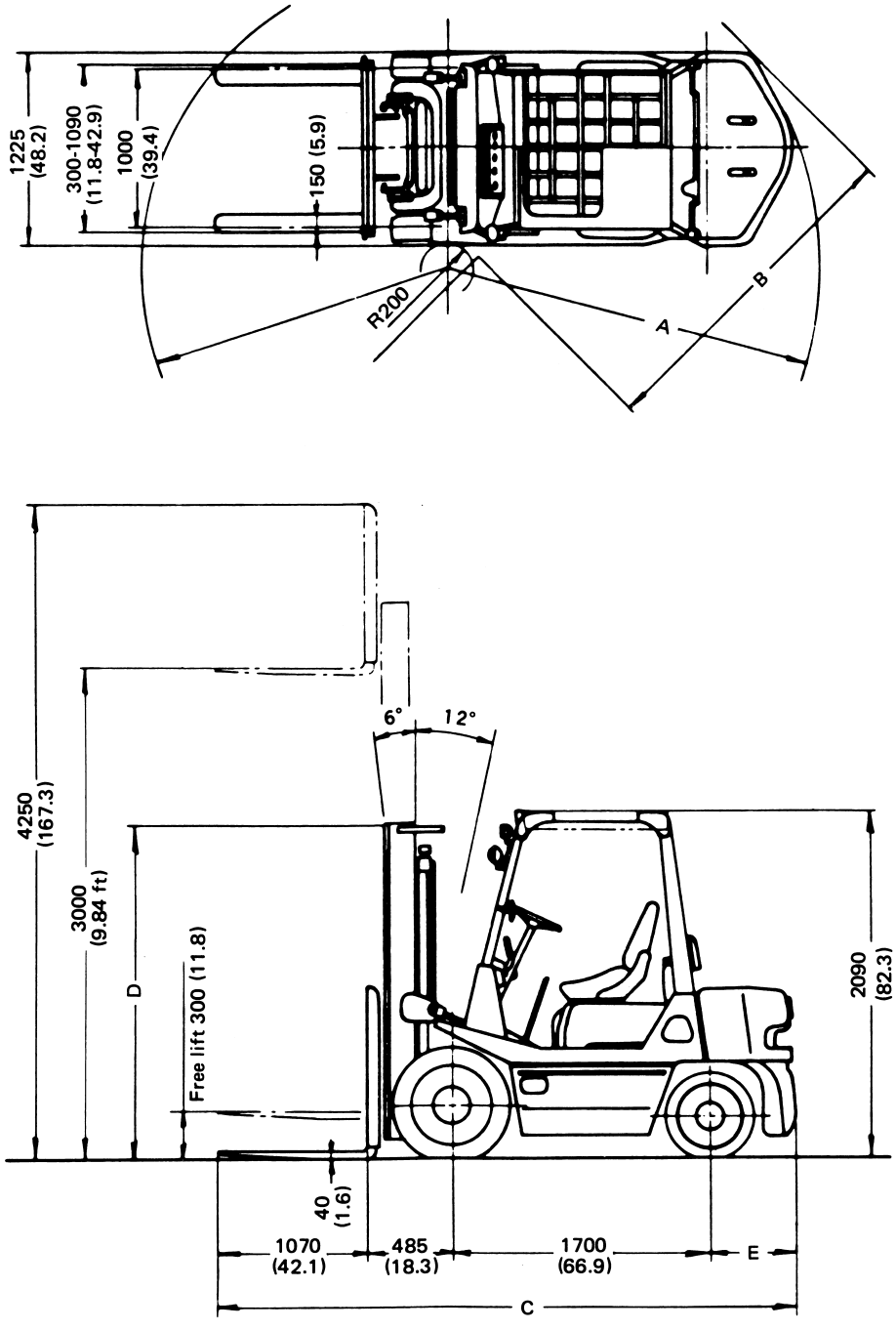


Fig. 6 External View

SPECIFICATIONS

(C : Clutch, T : Torque converter)

Item \ Model		FG28N7S		FG30N7S		FD28Z7S		FD30Z7S	
		C	T	C	T	C	T	C	T
Performance									
Rated load		2750 kg (5500 lbs)		3000 kg (6000 lbs)		2750 kg (5500 lbs)		3000 kg (6000 lbs)	
Basic load center		500 mm (24 in)		←		←		←	
Lift height		3000 mm (118.1 in)		←		←		←	
Tilt angle, fwd		6°		←		←		←	
bwd		12°		←		←		←	
Free lift		305 mm (12 in)		←		←		←	
Lift speed, unloaded		470 mm/S (92.5 ft/min)		450 mm/S (88.6 ft/min)		470 mm/S (92.5 ft/min)		←	
loaded		420 mm/S (82.5 ft/min)		400 mm/S (78.5 ft/min)		440 mm/S (86.5 ft/min)		←	
Travel speed									
Fwd, 1st		8 km/h (5 mile/h)	19.0 km/h (12 mile/h)	←		←		←	
2nd		19.0 km/h (12 mile/h)	–	←		←		←	
Rev, 1st		8 km/h (5 mile/h)	19.0 km/h (12 mile/h)	←		←		←	
2nd		19.0 km/h (12 mile/h)	–	←		←		←	
Max. drawbar pull, unloaded		950 kg (2100 lbs)		←		←		←	
loaded		1150 kg (2500 lbs)	1350 kg (2950 lbs)	←		1200 kg (2650 lbs)	1500 kg (3307 lbs)	←	
Gradeability, unloaded		1/5		←		←		←	
loaded		1/6 • 1/5							
Min. turning radius	A	2380 mm (93.7 in)		2420 mm (95.3 in)		2380 mm (93.7 in)		2420 mm (95.3 in)	
Min. intersecting aisle	B	2090 mm (82.3 in)		2120 mm (83.5 in)		2090 mm (82.3 in)		2120 mm (83.5 in)	
Dimensions									
Overall length	C	3720 mm (146.5 in)		3765 mm (148.2 in)		3720 mm (16.5 in)		3765 mm (148.2 in)	
Overall width		1225 mm (48.2 in)		←		←		←	
Overall height, at mast	D	2085 mm (82.1 in)		2070 mm (81.5 in)		2085 mm (82.1 in)		2070 mm (81.5 in)	
at overhead guard		2090 mm (82.3 in)		←		←		←	
Overall height with extended mast		4250 mm (167.3 in)		←		←		←	
Weel base		1700 mm (66.9 in)		←		←		←	
Tread, front		1000 mm (39.4 in)		←		←		←	
rear		970 mm (38.2 in)		←		←		←	
Fork overhang		490 mm (19.3 in)		←		←		←	
Rear overhang	E	465 mm (18.3 in)		510 mm (20.1 in)		465 mm (18.3 in)		510 mm (20.1 in)	
Fork size (Length x width x thick.)		1070 mm x 125 mm x 45 mm (42.1 in x 4.9 in x 1.8 in)		←		←		←	
Fork spacing		250-1090 mm (9.84-42.9 in)		←		←		←	
Under clearance, at mast		135 mm (5.7 in)		←		←		←	
Weight									
Operating weight		4050 kg (8930 lbs)		4230 kg (9327.1 lbs)		4140 kg (9129 lbs)		4320 kg (9525.6 lbs)	

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1. ENGINE

1-1 H20 GASOLINE ENGINE (FG20N2S, FG23N2S, FG25N2S, FG28N7S, FG30N7S)

MODEL:	H20, NISSAN
TYPE:	4-cycle, water-cooled,in-line, overhead valve type gasoline engine.
CYLINDER:	
No. of cylinders-bore x stroke:	4-87.2 mm x 83 mm (4-3.43 in x 3.27 in)
TOTAL DISPLACEMENT:	1982cc (120.9 in^3)
COMPRESSION RATIO:	9.1
ENGINE PERFORMANCE:	
Rated speed:	2300 rpm
Rated output:	41 PS (45HP)
Maximum torque:	13.5 kg-m @ 1800 rpm (101 ft-lbs @ 1800 rpm)
No-load minimum rpm:	700^{+50}_{-0}
Full-load minimum fuel consumption (@ rated rpm):	220 g (0.51 lbs)/Psh
DIMENSION & WEIGHT:	
o.a. lenght x o.a. width x o. a. height,	w. clutch: 781.3 mm x 558 mm x 644.4 mm (39.9 x 21.2 x 25.3 in)
	w/o clutch: 705.3 mm x 558 mm x 644.4 mm (27.4 x 21.2 x 25.3 in)
Weight:	w. clutch: 196 kg (432.2 lbs), w/o clutch : 186 kg (410.1 lbs)
ROTATIONAL DIRECTION:	Clockwise when viewed from fan side.
CONSTRUCTION:	
Type of piston:	Auto-thermic type
No. of pressure rings	2
No. of oil rings	1
Type of cylinder liner:	Cylinder and block cast in one piece
Valve operation:	
Suction valve (open), BTDC:	16°
(closed), ABDC:	52°
Exhaust valve (open), BBDC:	54°
(closed), ATDC:	14°
Valve clearance:	
Suction valve:	0.38 mm (0.015 in) hot
Exhaust valve:	0.38 mm (0.015 in) hot
Ignition system:	Battery coil type
Ignition timing:	BTDC 8° @ 700 rpm
Ignition order:	1–3–4–2
Ignition coil:	STC, HANSHIN HENATSUKI
Distributor:	T4T–717, MITSUBISHI

Ignition plug:	B-4ES (NIHON TOKUSHU TOGYO)
Size:	14 mm (0.6 in)
Spark gap:	0.7-0.8 mm (0.028-0.032 in)
Governor:	Pneumatic type, fixed range control
Carbureter:	212030-H-101, (NIHON KIKAKI)
Gas valve diameter:	28 mm (1.18 in)
Venturi diameter:	22 mm (0.95 in)
Fuel pump:	Diaphragm type
Air cleaner:	Filter paper type
Lubrication system:	Forced lubrication
Lubrication oil pump:	Gear type
Lube oil filter:	Filter paper
Filteration:	Full flow-filteration
Cooling system:	Water cooling forced circulation
Cooling fan:	Pusher type six-blade, O.D. of 390 mm (15.4 in)
Driving method:	V-belt drive, pulley ratio 1 : 0.86
Water pump:	Centrifugal type
Driving method:	V-belt drive, pulley ratio 1 : 0.86
Water temperature regulator:	Wax type (valve opening temp:82°C or 179.6°F)
Starting motor:	Magnet shift type, M3T218, MITSUBISHI ELECTRIC
Voltage:	12V
Output:	0.8KW
Charging generator:	AIT22, MITSUBISHI ELECTRIC
Voltage:	12V
Output:	35A
Generation:	3-phase AC
Driving method:	V-belt drive, pulley ratio 1 : 2.18
Charging regulator:	MITSUBISHI ELECTRIC
Type:	IC Regulator, Built-in type
Reference data:	
Lube oil:	4.2ℓ (1.1 US gal) [Oil pan:3.7ℓ (0.98 US gal) Oil filter:0.5ℓ (0.13 US gal)]
Cooling water (for engine):	3.5ℓ (0.93 US gal)

1-2 C240PKJ DIESEL ENGINE (FD20Z2S, FD23Z2S, FD25Z2S, FD28Z7S, FD30Z7S)

MODEL:	C240PKJ, ISUZU MOTORS
TYPE:	4-cycle, water-cooled overhead valve, in-line, vortex chamber type diesel engine
CYLINDER:	
No. of cylinders-bore x stroke:	4-86 mm x 102 mm (4-3.39 in x 4.02 in)
TOATL DISPLACEMENT:	2369cc (144.6 in^3)
COMPRESSION RATIO:	20
ENGINE PERFORMANCE:	
Rated speed:	2500 rpm
Rated output:	44 HP
Maximum torque:	13.7 kg-m @ 1800 rpm (105 ft-lbs @ 1800 rpm)
No-load minimum speed:	700 ± 25 rpm
Full-load minimum:	
fuel consumption (@ rated rpm):	Less than 212g (467 lbs)/psh
DIMENSIONS & WEIGHT:	
o.a. length x o.a. width x	
height:	713 mm x 561 mm x 667 mm (28.1 in x 22.1 in x 26.3 in)
Dry weight:	252 kg (555.7 lbs)
ROTATIONAL DIRECTION:	Clockwise when viewed from fan side
FIRING ORDER:	1-3-4-2
CONSTRUCTION:	
Injection pump	BOSCH, Distributed type, DIESEL KIKI
Plunger:	9 mm dia. x 2.2 mm (0.35 in dia x 0.09 in)
Injection nozzle:	Throttle type, DIESEL KIKI
Fuel feed pump:	Sedimenter, DIESEL KIKI
Fuel filter:	Paper filter type, TOKYO ROKI
Governor:	DIESEL KIKI
Governing method:	Centrifugal type, all-speed control
Lubrication method:	Forced lubrication
Lubrication:	Forced lubrication
Lube oil pump:	Trochoid pump
Driving method:	Camshaft drive
Oil pressure regulator:	Ball spring type
Oil pressure indicator:	Electric contact type
Lube oil filter:	Full flow-filteration, TOKYO ROKI
Cooling system:	Water cooling

Cooling fan:	Pusher type, six-blade, dia. of 380 mm (15in)
Driving method:	V-belt drive
Water pump:	Vortex type
Driving method:	V-belt drive
Water temperature regulator:	Wax pellet type-FUJI TOMSON
Air cleaner:	Filter paper type, TSUCHIYA
Starting motor	HITACHI
Voltage:	12V
Output:	2.2kW
Preheater:	Provided
Charging generator:	
Voltage:	12V
Output:	35A
Generation:	AC generation, diode rectification
Automatic charging regulator:	Built in charging generator
Reference data:	
Oil sump:	4.0-5.2 ℓ (1.06-1.37 US gal)
Injection pump chamber:	0.08 ℓ (0.02 US gal)
Cooling water (for engine only):	5.2 ℓ (1.37 US gal)

	Valve clearance	Open	Close
Suction	Cold : 0.45 mm Hot : –	Before TDC : 11°	After BDC : 49°
Exhaust	Cold : 0.45 mm Hot –	Before BDC : 51°	After TDC : 9°

Injection timing:	Before TDC 9°
Injection start pressure:	120kg/cm² (1707 psi)
Compression pressure:	31kg/cm², 200 rpm (441/psi)
Water temperature regulator, Opening:	76.5°C (169.7°F)
Temperature at which a stroke of more than 8 mm (0.31 in) is attained:	90°C (194°F)

1-3 MAINTENANCE

1-3-1 ENGINE SPEED ADJUSTMENT

Adjustment of engine RPM has an influence on operation efficiency such as travel speed or lift speed, so it is required to check the engine speed and adjust in the following manner, if the specified speeds are not obtained.

(1) Adjustment of idle speed (for gasoline engine)

(a) Warm up engine until the engine coolant temperature reaches 85°C (185°F).

(b) Install a tachometer on the engine and set the engine speed to 700rpm. By using the carburetor throttle adjusting screw.

(c) Turn the mixture adjusting screw in such a direction that the engine speed increases.

(d) Set the engine speed to 700rpm again with the throttle adjusting screw.

(e) Repeat Steps (c) and (d) until the steady engine speed of 700rpm is gained.

(2) No-load max. speed adjustment (for gasoline engine)

(a) Warm up the engine until engine coolant reaches 85°C (185°F).

(b) Shut off the engine. Make sure that the throttle valve is fully opened when the accelerator pedal is fully pressed.

(c) Start the engine and fully open the throttle valve.

(d) If the engine speed is higher than the specified one, turn the adjustring screw handle of the governor to the left, and if lower, turn it to the right.

No-load max. speed: 2950 – 3050 rpm

2. FUEL SYSTEM

Fuel Tank Capacity:	52ℓ (13.74 US gal)
Fuel Gauge:	
Type:	Bimetal type
Unit Resistance:	
Full:	9.5-11Ω
Empty:	82-92Ω

2-1. GENERAL DESCRIPTION

The fuel system consists of a tank which is made into one piece with the machine frame, tank unit to detect the remaining fuel in the tank, and fuel meter to indicate the fuel level.

2-1-1. FUEL TANK

The fuel tank, of the welded construction integrated with the machine frame, is located on the left side frame and has a capacity of 52ℓ (13.74 US gal). On the tank is a tank cover on which the tank unit is installed to detect the fuel level.

The fuel tank design is almost the same for the gasoline and diesel engine type machines except that the gasoline engine type machine has a cap on the return pipe.

[105561]

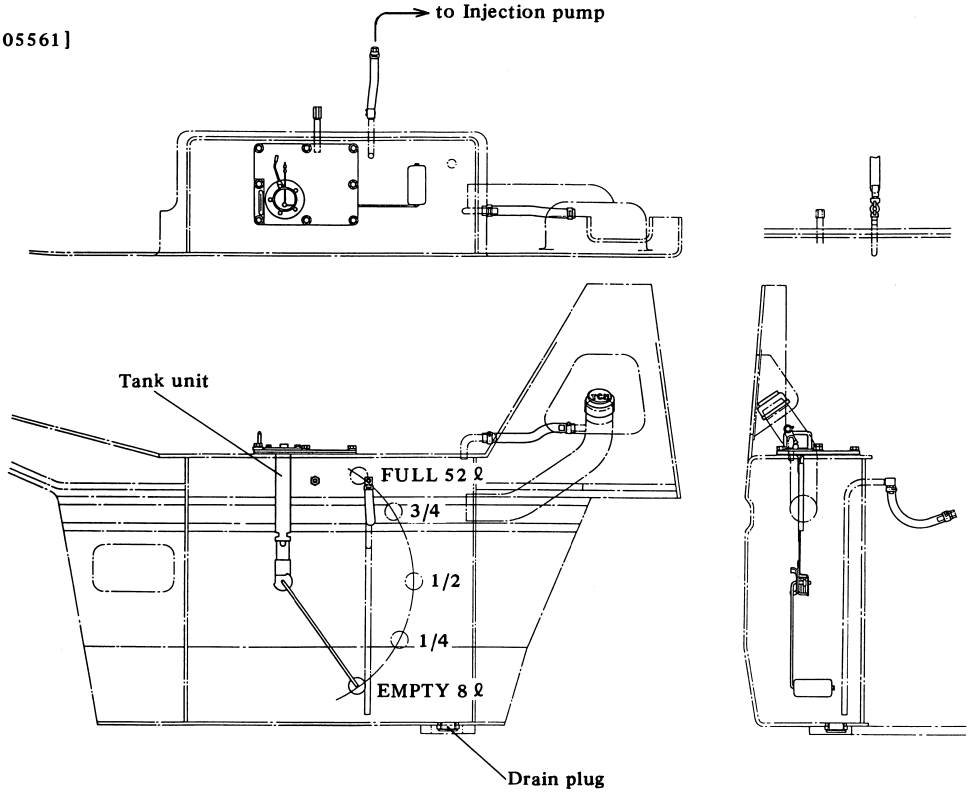


Fig. 2-1 Fuel Tank (for Gas.)

[105562]

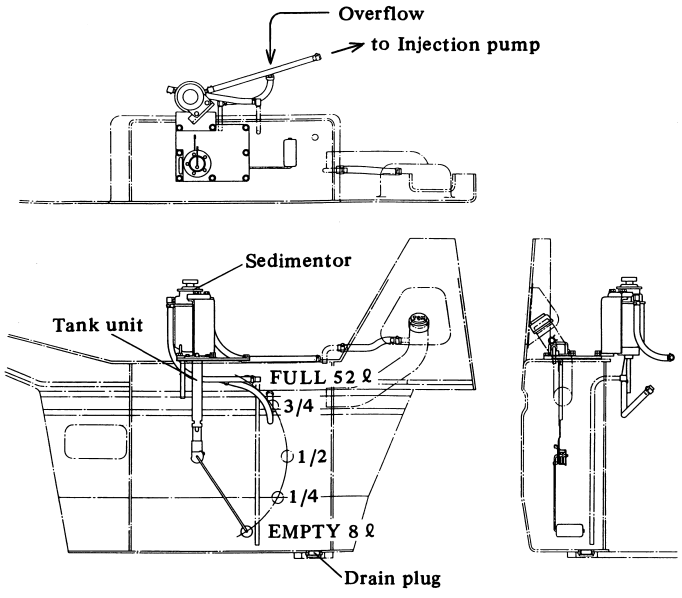


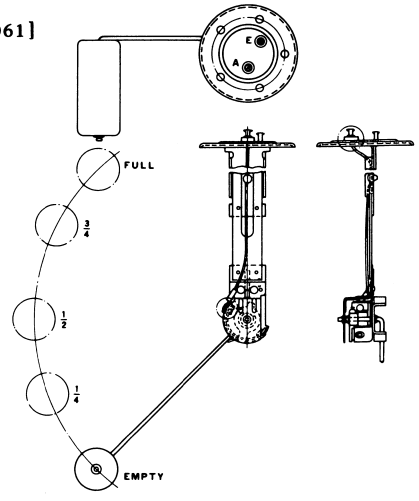
Fig. 2-2 Fuel Tank (for Diesel)

2-1-2. TANK UNIT AND FUEL METER

The tank unit is designed to convert the remaining fuel amount into electric voltage. See Fig. 2-2. For this purpose, a variable resistor with nichrome wire is used and the sliding element is linked with the float. As the float moves up and down, resistance is changed so that the amount of electric voltage passing across the resistor is also changed .

The fuel meter is a bimetal type and its pointer swings depending on the amount of electric current passing through the heating unit of bimetal. When the float is at the highest position, resistance of the tank unit is approximately 9.5 to 11 Ω. This will allow much electric current to flow, so the bimetal crooks largely, causing the fuel meter pointer to swing into the lowest part. On the other hand, as the fuel level lowers and the float goes down, resistance is increased, so electric currenst is reduced, causing the pointer to swing to the "E" side.

[222A2-22061]



Float	Resistance (Ω)
Full	$10^{+1.0}_{-0.5}$
3/4	(19)
1/2	32 ± 3
1/4	(49.5)
EMPTY	80^{+12}_{+2}

Fig. 2-3. Tank Unit

2-2 FUEL SYSTEM MAINTENANCE

Perform the fuel system maintenance service every 100 operating hours in the following manner. Also clean the fuel tank every 600 operating hours.

2-2-1 FUEL FILTER

The fuel filter is designated to remove dust or foreign matter from fuel, which is located between the priming pump and injection pump (for dierel engines) or between the fuel tank and fuel pump (for gasoline engines).

- **Gasoline engine fuel filter service**

(1) Remove drain plug (7) to drain off gasoline from the bowl.

(2) Loosen nut (1) and remove the bowl.

(3) Remove spring (3) and filter (4) from the fuel pump upper part.

(4) Wash filter (4) in gasoline to remove dust.

(5) If filter (4) is damaged, replace with new one. Even if not damaged, the filter should be replaced every 600 operating hours.

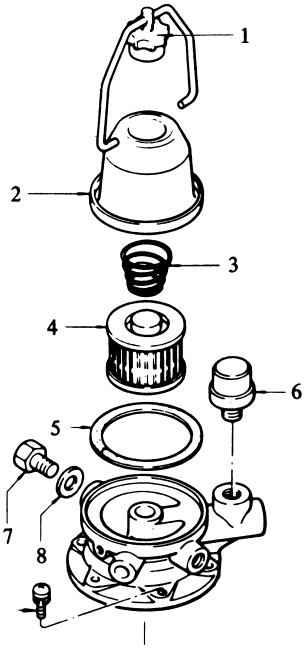


Fig. 2-4

(6) Reinstall the filter, spring and bowl on the pump and lock with nut (1).
(7) Attach drain plug, start the starter motor to prime gasoline into the bowl.
(8) Check for gasoline leak between pump body and bowl (2) and the packing section of plug (7). If any leak is noticed, replace packings (8) and (5).

2-2-2 CLEANING FUEL TANK

Clean the fuel tank every 600 hours of operation, observing the cautions given below. Special care should be exercised when working on the gasoline tank. The fuel tank cleaning service should be performed when the tank contains fuel as little as possible.

[CAUTION]

- Perform this service outdoors and keep away naked flame from the area.
- Make sure you know where the fire extinguishers are kept and how to use them.
- To catch fuel drained off from the tank, be sure to use a metallic pan.
- The pan and the truck body should be connected with conductor wire.

(1) Loosen the drain plug and drain off fuel from the tank. If the fuel to be drained off is gasoline, connect the pan and the truck body with conductor.

(2) Remove the tank cover

(3) Wash the inside of tank with cleaning solvent.

(4) Remove the packing attached on the tank cover mounting part. With a new packing, reinstall the tank cover.

(5) Reinstall the drain plug.

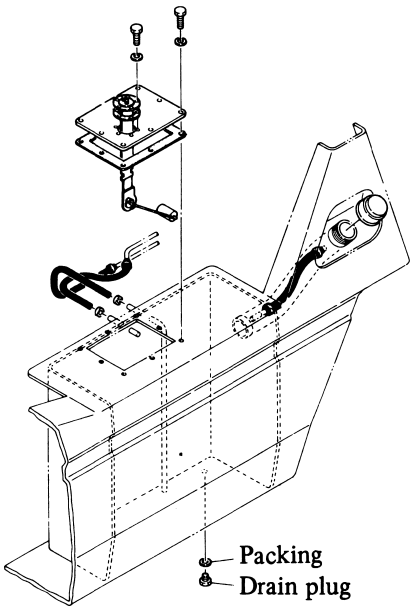


Fig. 2-5.

3. ELECTRIC SYSTEM

Bulb Specifications:		
Head light:	(A)	35W/35W
Turn signal light:	(B)	20W
Parking light:	(C)	5W
Tail light:	(D)	8W
Braking light:	(E)	23W
Back-up light:	(F)	10W
License plate light:	(G)	10W
Battery warning light:		1.4W
Pressure warning light:		1.4W

3-1 GENERAL DESCRIPTION

The electric system is composed of a starter circuit, charging circuit and lighting circuit which are respectively activated by the 12-volt batteries. The wiring used for each circuit is classified by color and given sufficient current capacities. In addition, the wiring is further divided into the engine wiring, cabinet wiring, meter panel wiring and overhead guard wiring, each connected with couplers.

[105593]

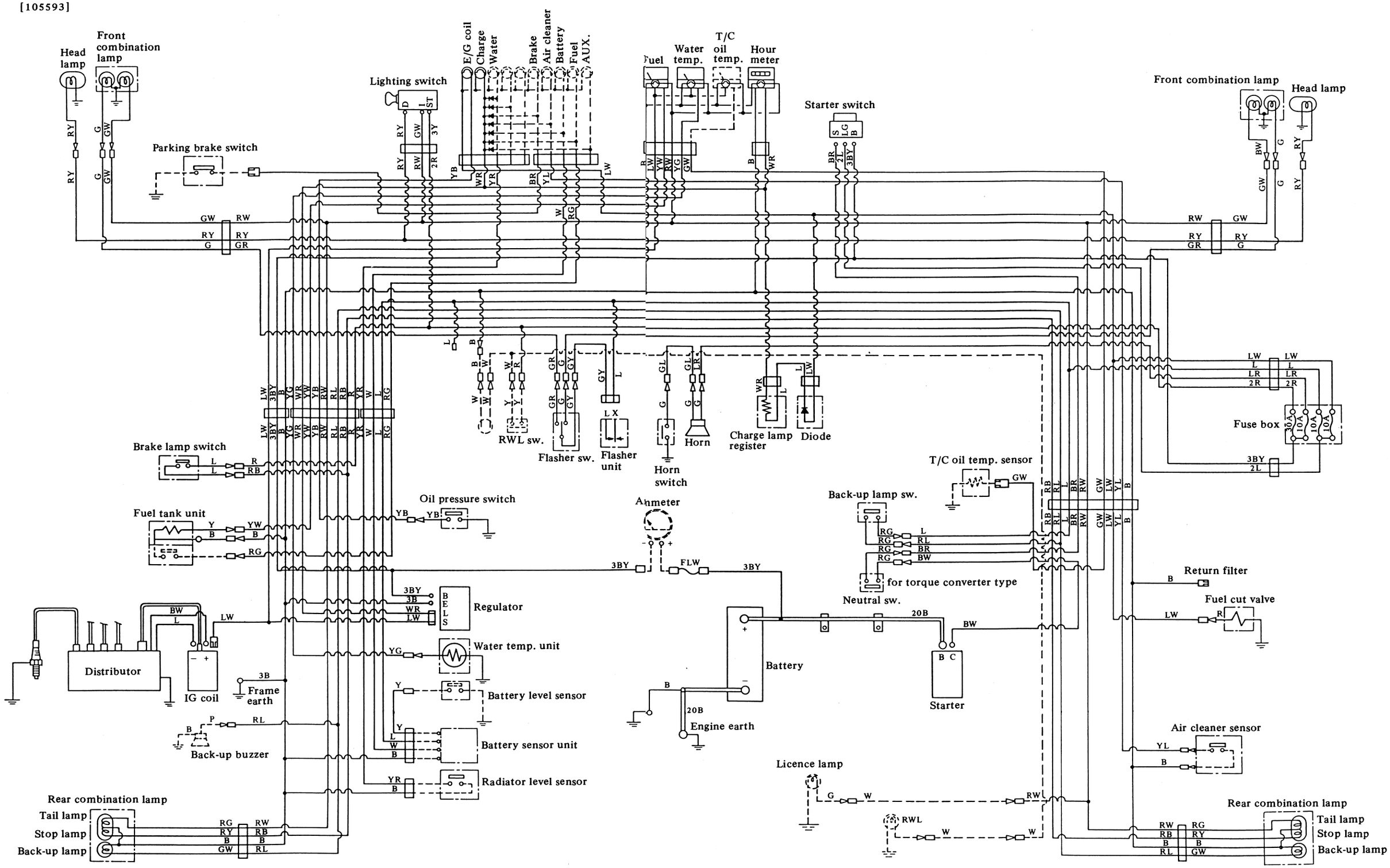


Fig. 3-1 Wiring Diagram for Gas Engine Model

[105592]

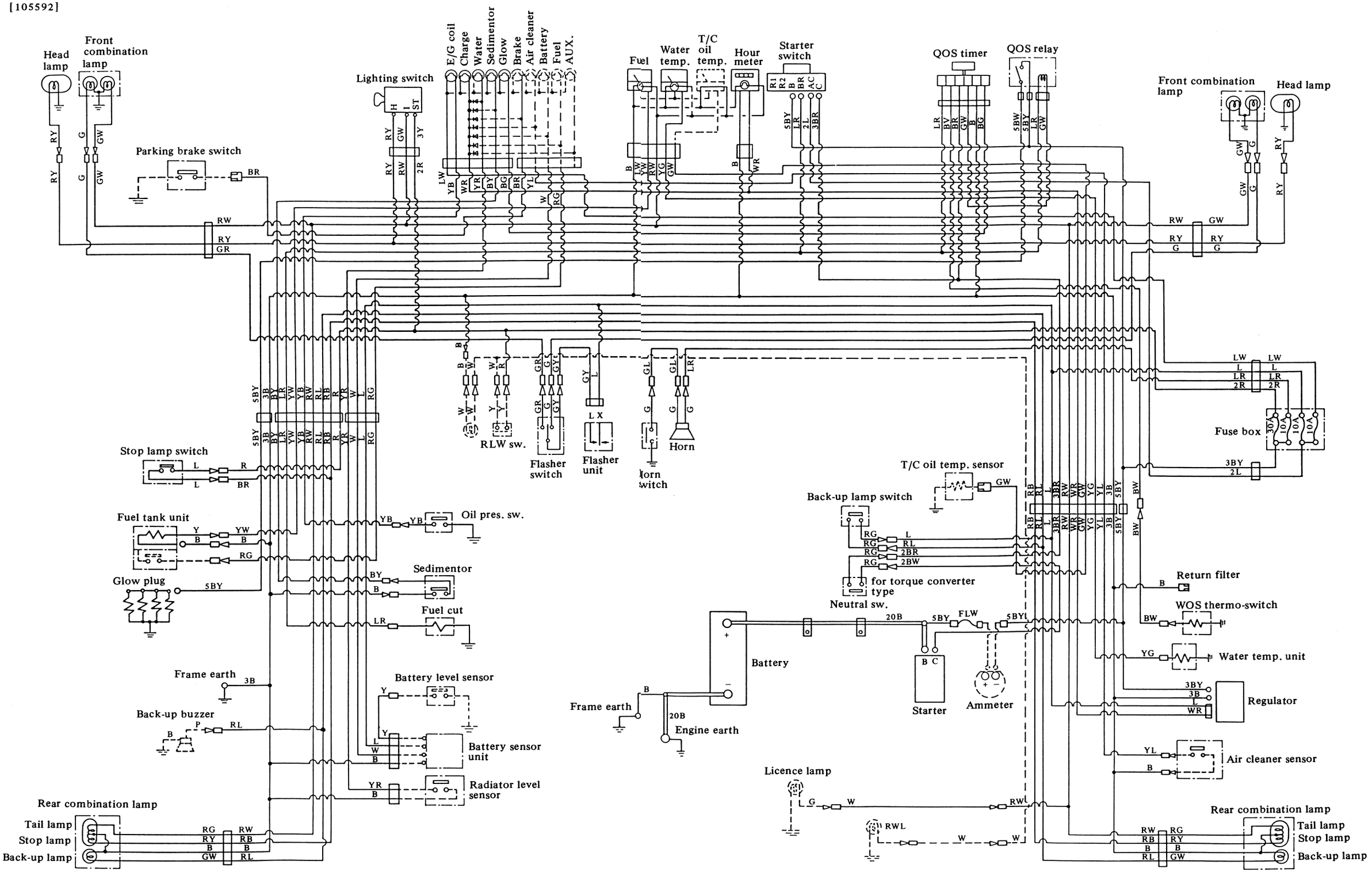


Fig. 3-2 Wiring Diagam for Diesel Engine Model

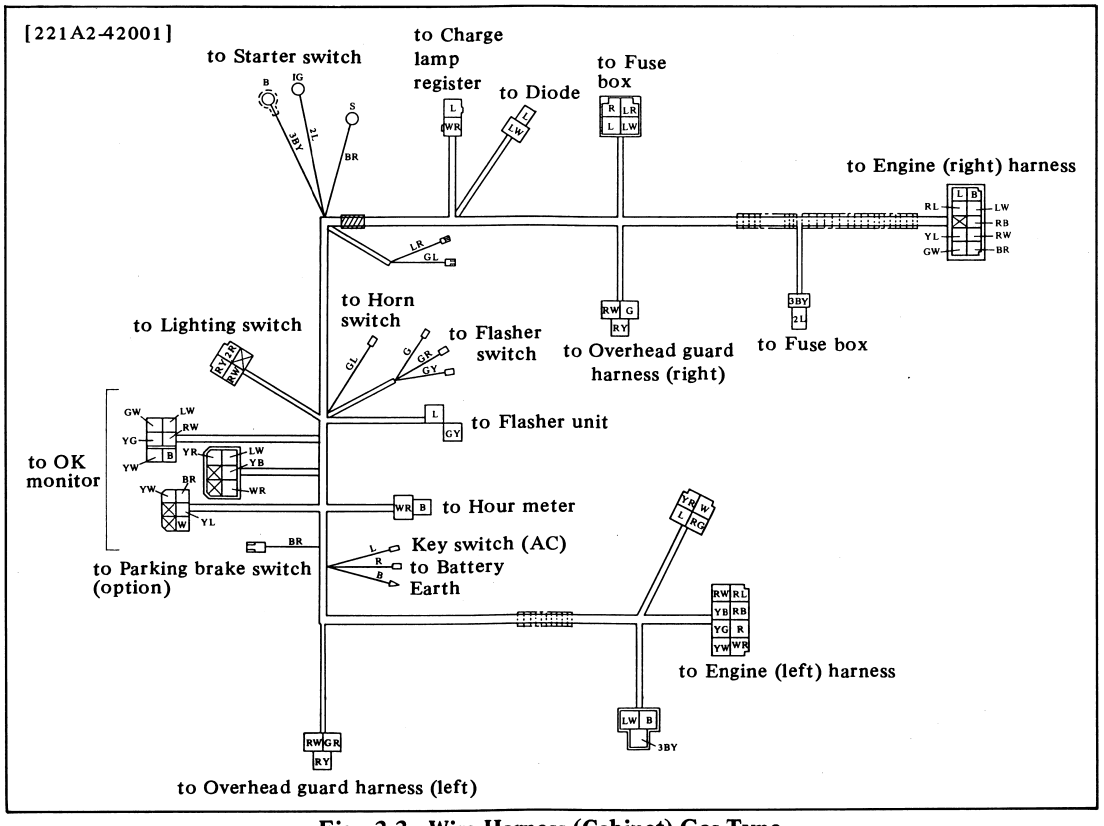


Fig. 3-3 Wire Harness (Cabinet) Gas Type

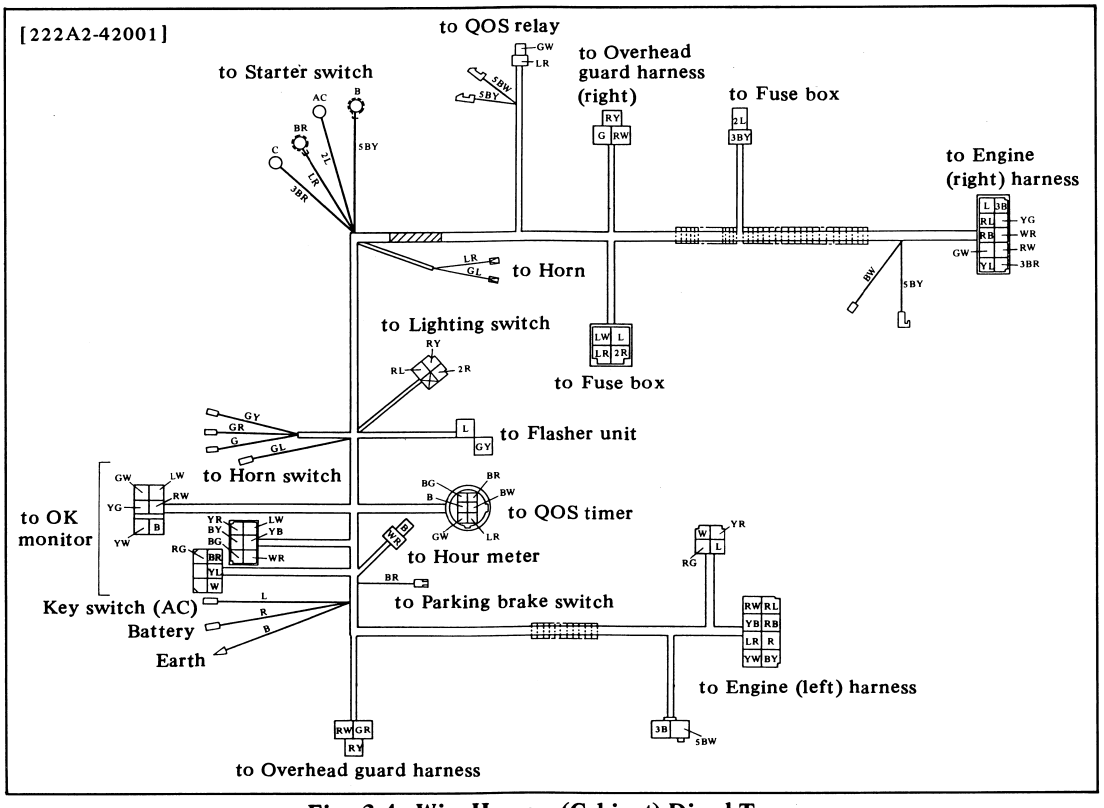


Fig. 3-4 Wire Harness (Cabinet) Diesel Type

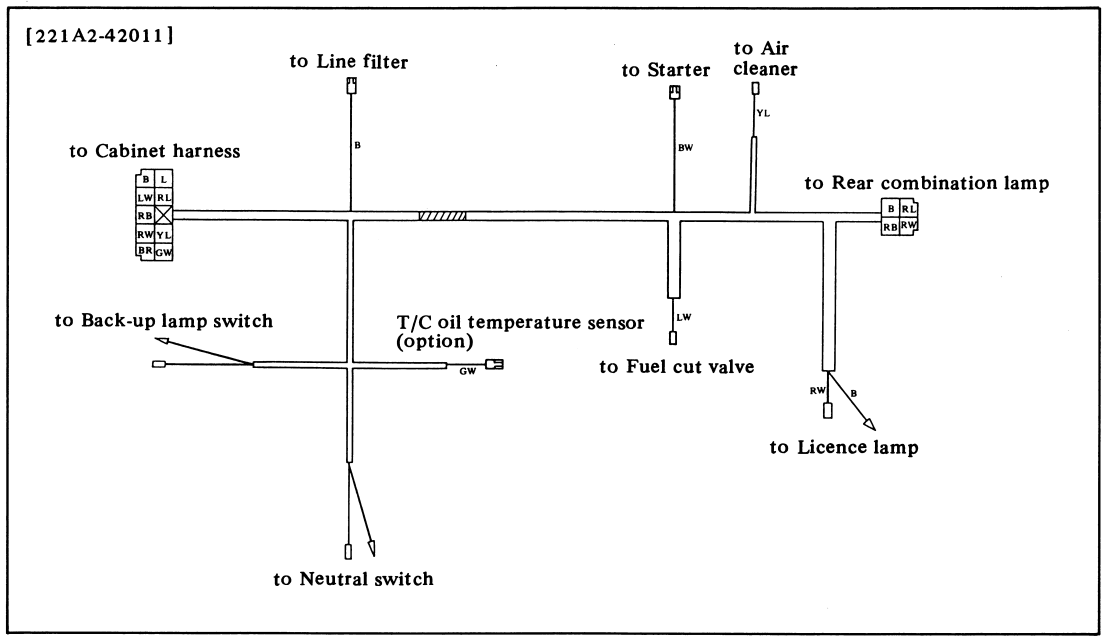


Fig. 3-5 Wire Harness (Gas Engine Right)

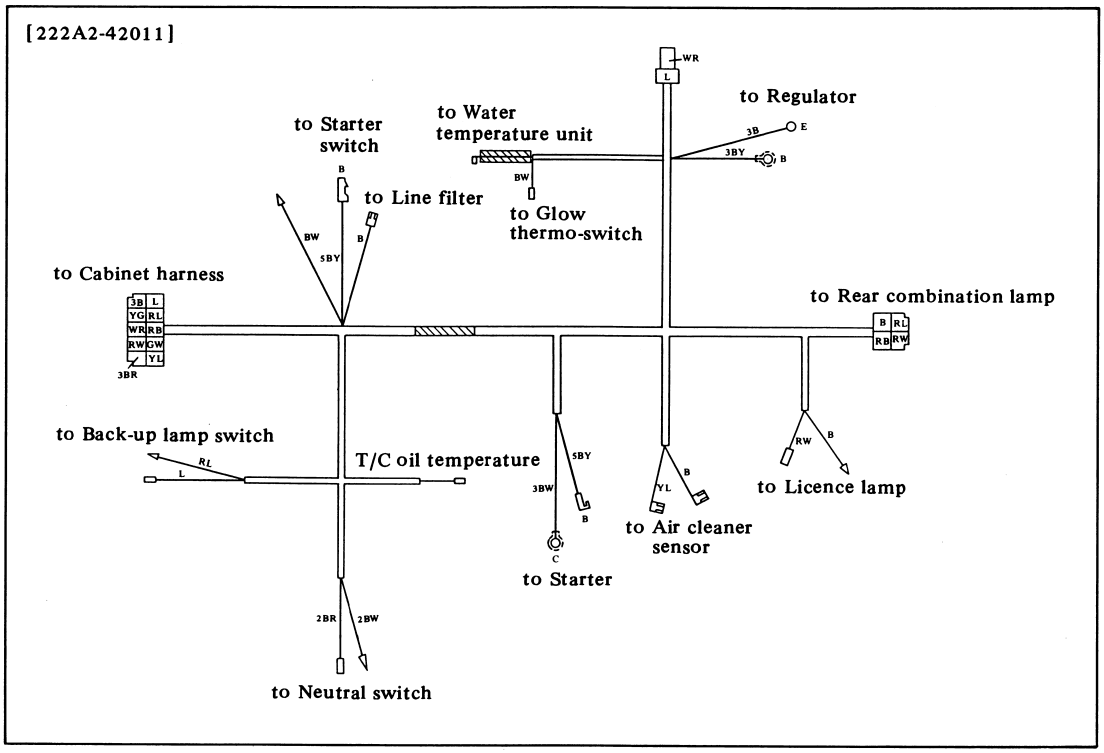


Fig. 3-6 Wire Harness (Diesel Engine Right)

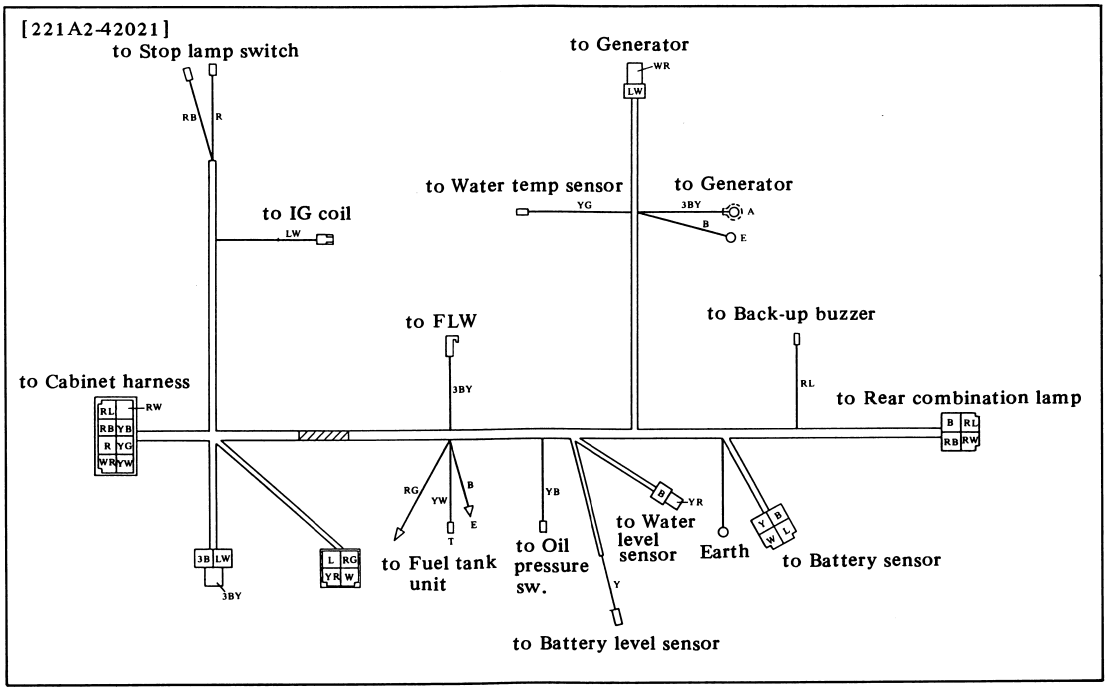


Fig. 3-7 Wire Harness (Gas Engine Left)

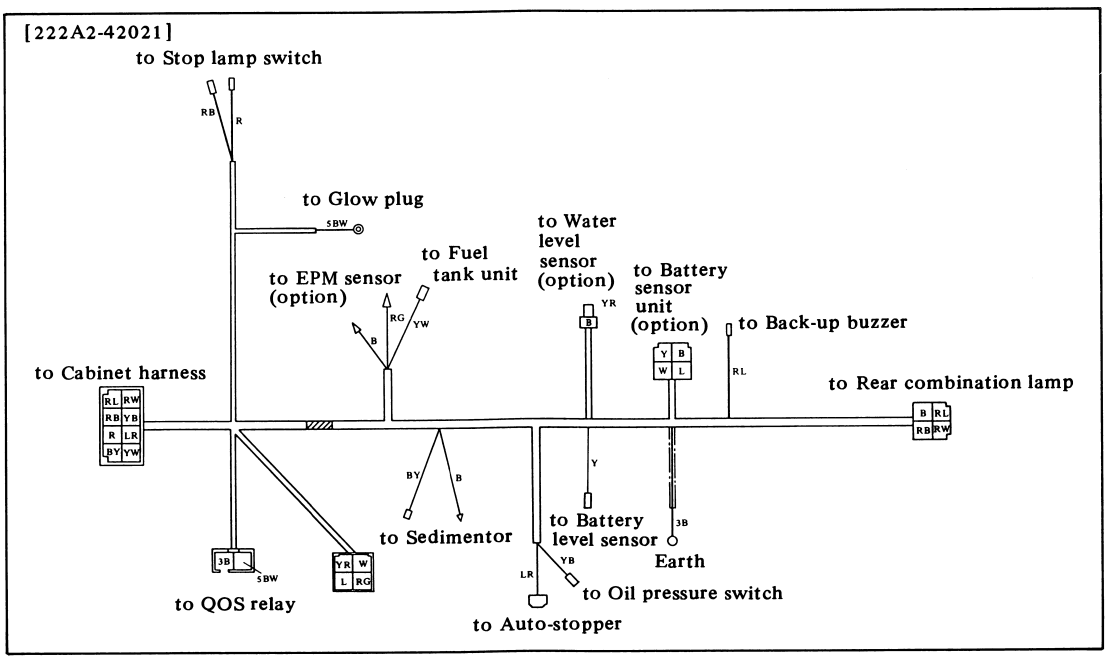


Fig. 3-8 Wire Harness (Diesel Engine Left)

4. CLUTCH AND CLUTCH PEDAL

	FG20N2S FG28N7S FG23N2S FG30N7S FG25N2S	FD20Z2S FD28Z7S FD23Z2S FD30Z7S FD25Z2S
Type:	Dry single plate	
Operation:	Foot-pedal type	
Facing size:		
Outer diameter:	275 mm (10.8 in)	←
Inner diameter:	175 mm (6.9 in)	180 mm (7.1 in)
Thickness, locked:	7.2 mm (0.28 in)	8.0 mm (0.32 in)
Surface Area:	352 cm^2 (54.6 in^2)	340 cm^2 (53 in^2)
Weight, approx:	10 kg (22.1 lbs)	←

4-1 GENERAL DESCRIPTION

The clutch consists primarily of a clutch disk and pressure plate. The clutch disk is a dry single plate type, and the pressure plate is bolted to the engine flywheel, with the clutch disk sandwiched between both. The clutch housing cover, having a vent pipe, cools the clutch. The clutch pedal has the design as shown in Fig. 4-1 and is located on the transmission.

4-1-1 CLUTCH PEDAL

The clutch pedal is fitted on the same bracket as the brake pedal and is secured on top of the transmission. The clutch pedal boss has a bushing. The clearance between the bushing inner surface and shaft is lubricated with grease.

4-2 MAINTENANCE

4-2-1 REPLACEMENT OF CLUTCH DISK

(1) Press the clutch pedal and place spacers at three points between the clutch cover and release lever.
(2) Turn the slide bolt in the counterclockwise direction to let the drive shaft go into the transmission.
(3) Remove the clutch cover mounting bolts and remove the clutch disk.
(4) Install a new clutch disk, with the longer spline boss pointing toward the transmission.
(5) Turn the slide bolt step by step in the clockwise direction and pull out the slide bolt, matching the drive shaft spline with the clutch disk spline.

(6) After making certain that the drive shaft end has entered the pilot bearing, tighten the slide bolt to the torque of 10.9-12.1 kg.m (78.8-87.5 ft.lbs).
(7) Install the clutch cover on the flywheel.
(8) Press the clutch pedal and remove spacers.
(9) Adjust the clutch pedal. (See Paragraph 4-2-2).

4-2-2 CLUTCH PEDAL ADJUSTMENT

(1) Loosen pedal stopper bolt (a).
(2) Adjust the pedal height for 120 mm (4.7 in) for the gasoline model and 113 mm (4.4 in) for the diesel model, using stopper bolt (a). See Fig. 4-1.
(3) Detach one end of the clutch lever spring and loosen clutch lever spherical nut (b).
(4) Press the clutch pedal about 40 mm (1.57 in) and hold it. Pull the clutch lever until increased resistance is felt, and hold it.
(5) Turn spherical nut (b) in the clockwise direction until it comes into contact with the clutch lever and lock with lock nut (c).
(6) Install clutch lever spring.
(7) If clutch pedal free travel becomes less than 40 mm (1.57 in) due to worn clutch disk, perform steps (3) thru (6).

[104831]

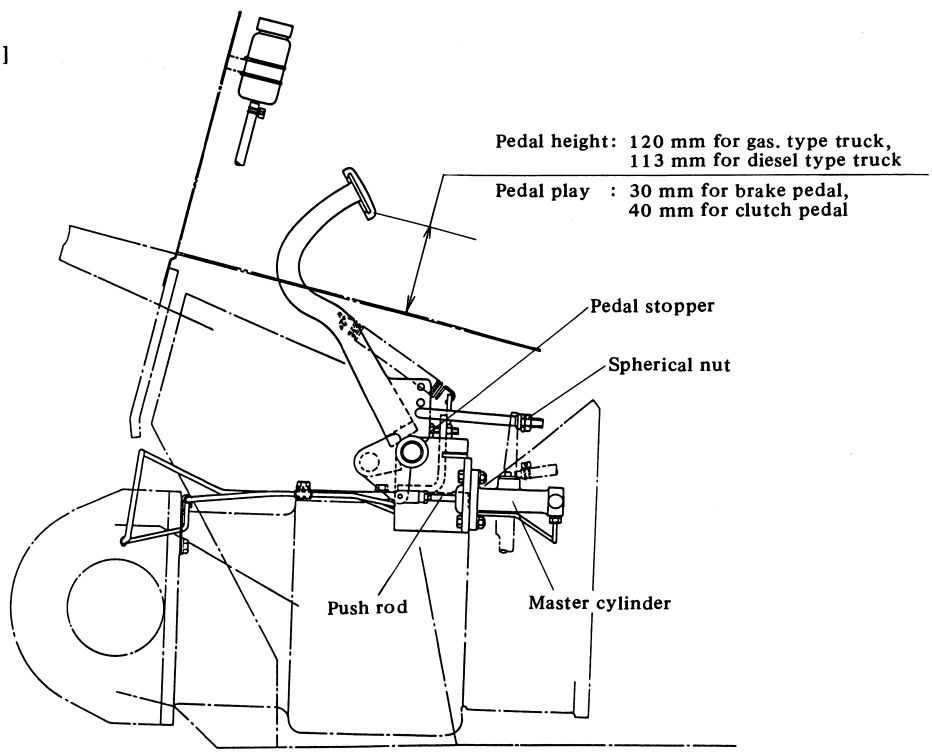

Pedal height: 120 mm for gas. type truck,
113 mm for diesel type truck
Pedal play : 30 mm for brake pedal,
40 mm for clutch pedal
Pedal stopper
Spherical nut
Push rod
Master cylinder

Fig. 4-1. Clutch Pedal

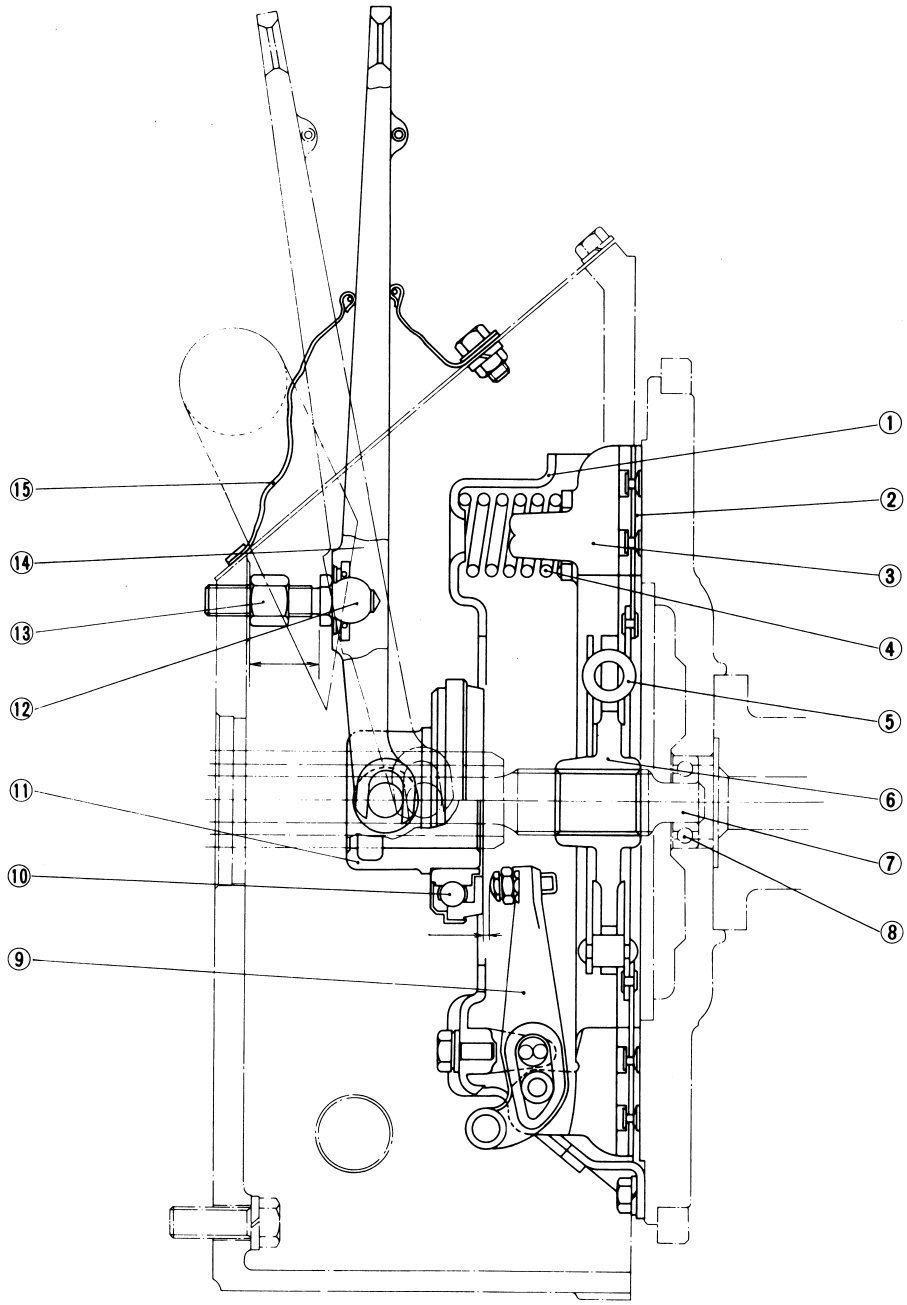


Fig. 4-2 Clutch (Gas Engine Type)

1. Clutch cover
2. Clutch disk
3. Pressure plate
4. Pressure spring
5. Torsion spring
6. Hub
7. Drive shaft
8. Pilot bearing
9. Release lever
10. Thrust bearing
11. Shift block
12. Pivot
13. Lock nut
14. Clutch yoke
15. Cover

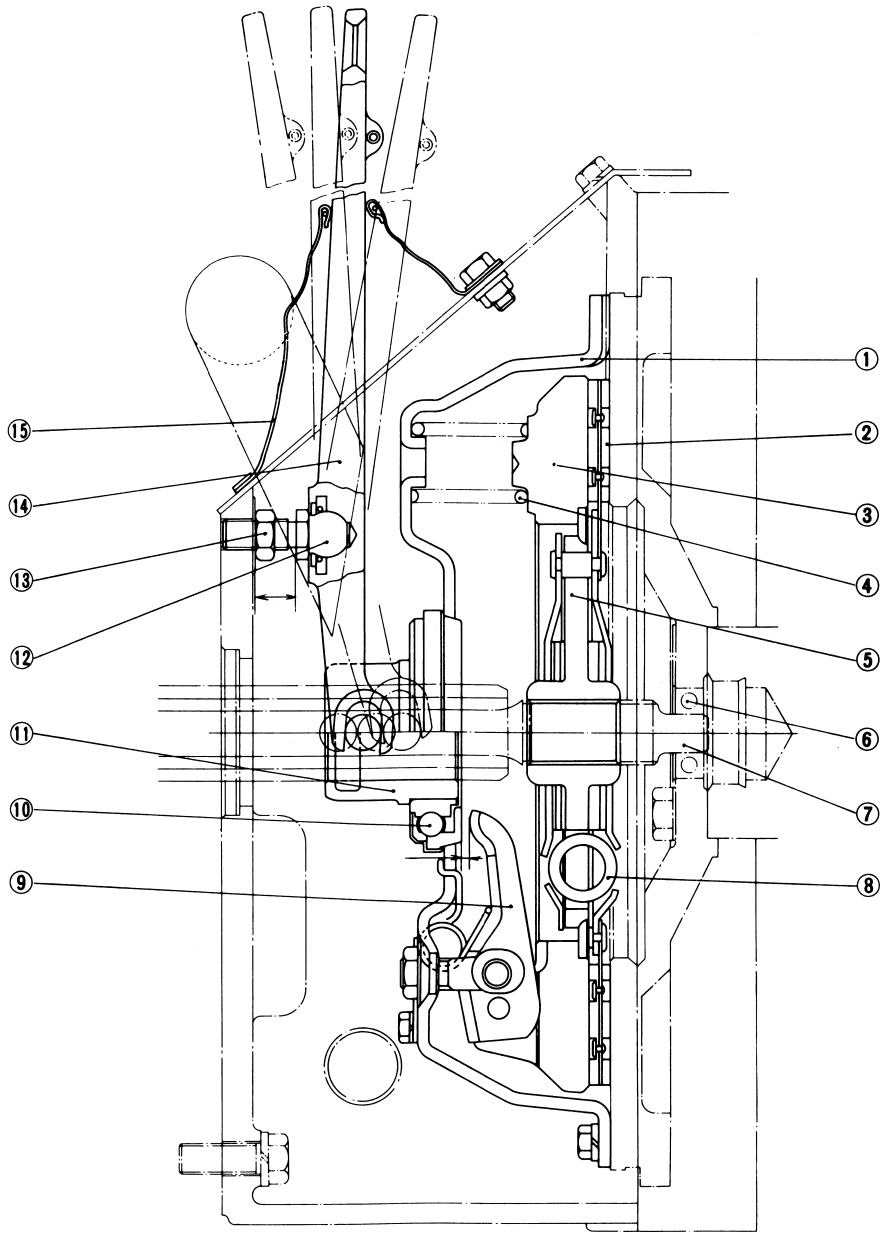


Fig. 4-3 Clutch (Diesel Engine Type)

1. Clutch cover
2. Clutch disk
3. Pressure plate
4. Pressure spring
5. Hub
6. Pilot bearing
7. Drive shaft
8. Torsion spring
9. Release lever
10. Thrust bearing
11. Shift block
12. Pivot
13. Lock nut
14. Clutch yoke
15. Cover

5. TRANSMISSION AND DIFFERENTIAL

	2 – 2.5 ton	2.8 – 3.0 ton
Transmission:		
Type:	Manual-shift synchro-mesh selective sliding type	←
Speeds:	2 fwd/rev	←
Gear Ratio:		
Fwd 1st:	3.388	3.253
Fwd 2nd:	1.575	1.407
Rev 1st:	3.394	3.205
Rev 2nd:	1.578	1.386
Reduction Gear:		
Reduction Gear:	Spiral bevel gear	←
Reduction Ratio:	2.1	1.91
Differential:		
Reduction Gear:	Straight spur gear	←
Reduction Ratio:	5.182	6.18
Differential Case:	Banjo-shaped	←
Differential Gear:	Straight bevel gear	←
Oil Amount:	8 ℓ (2.11 US gal)	6 ℓ (1.59 US gal)
Weight, in dry state	100 kg (221 lbs)	165 kg (364 lbs)

5-1. GENERAL DESCRIPTION

The transmission is a synchromesh type, making up a drive unit together with a reduction gear and differential as one body construction. The synchromesh transmission is provided with a synchronizer that synchronizes the rotation of gears which are about to be meshed ensuring smooth gearshifting. The transmission of this type permits the driver to avoid clashing gears during shifting and simplifies the shifting action without double clutching, especially from forward to reverse or reverse to forward.

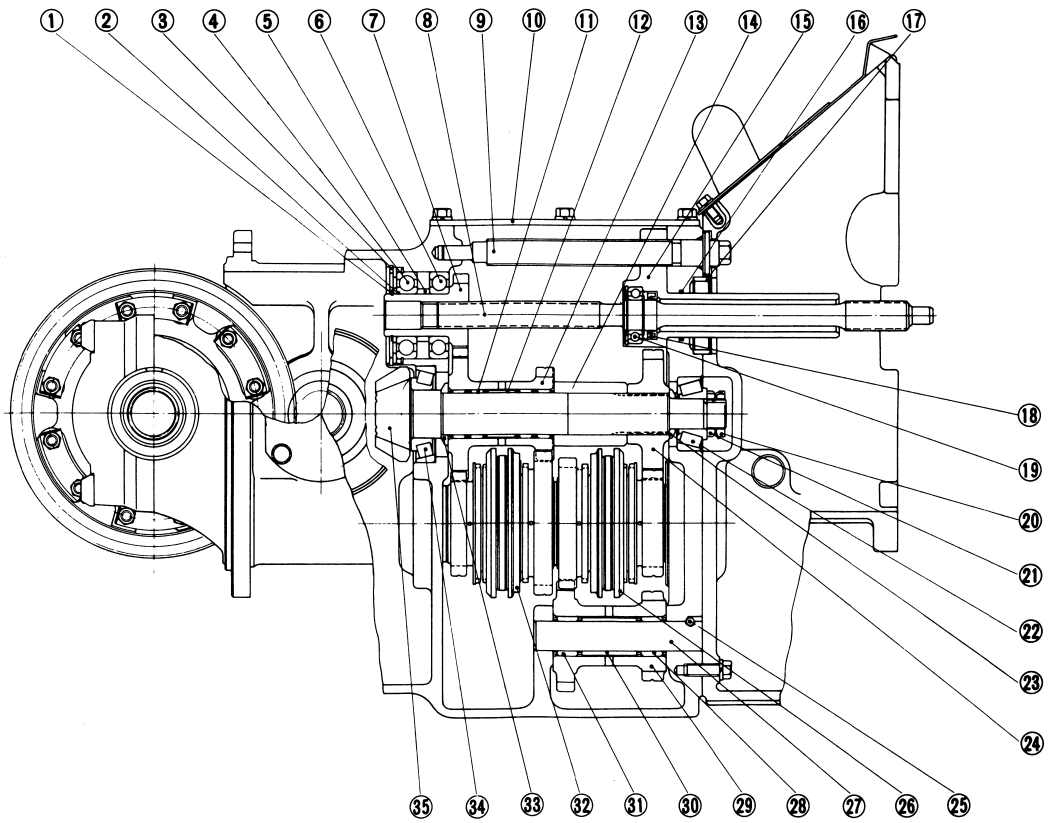


Fig. 5-1 Transmission

1. Snap ring
2. Spacer
3. Snap ring
4. Ball bearing
5. Spacer
6. Ball bearing
7. Input gear
8. Main drive shaft
9. Slide bolt
10. Cover
11. Needle bearing
12. Spacer
13. Cluster gear
14. Spacer
15. Bearing retainer
16. "O"-ring
17. Knock-out ring
18. Oil seal
19. Ball bearing
20. Lock nut
21. Bearing nut
22. Tapered roller bearing
23. Thrust bearing
24. Output gear
25. Ball
26. Clutch hub
27. Shaft
28. Needle roller bearing
29. Counter gear
30. Spacer
31. Needle roller bearing
32. Clutch hub
33. Thrust bearing
34. Tapered roller bearing
35. Output shaft

5-1-1 TRANSMISSION

The transmission consists primarily of a main drive shaft, output shaft, main shaft, and reverse idler shaft, each having gears of various sizes on it. The gears can be shifted with the aid of the sliding sleeves installed on the main shaft by operation of the shift arms.

The power from the output shaft is transmitted through the reduction gear and differential to the drive shaft.

(1) Main Drive Shaft and Slide Bolt

The front end of the main drive shaft is held by the pilot bearing located at the center of the engine flywheel, and the clutch side spline of the main drive shaft is fitted into the clutch disk hub. The main drive shaft, therefore, serves as an input shaft to transmit power to the inside of the transmission. Another spline is fitted into the input gear held against the transmission case by two ball bearings. The clutch side of the main drive shaft is held against the bearing retainer with the ball bearing and snap ring.

The input gear is always in mesh with the cluster gear installed on the output shaft. The bearing retainer which holds the main drive shaft is fitted to the transmission case with a slide bolt. When clutch disk replacement is required, the main drive shaft along with the bearing retainer can be moved by turning the slide bolt.

(2) Output Shaft

The cluster gear is installed on the output shaft through two needle bearings and a cluster spacer. Also the driven gear is splined to the output shaft through a spacer.

The output shaft is held against the transmission case with tapered roller bearings, and several shims are used to adjust the backlash between the output shaft gear and the bearing. The output side gear of the cluster gear is always in mesh with the input gear and high gear while the other side gear with the low gear.

The driven gear is splined to the output shaft and always in mesh with the forward gear and reverse idler gear.

(3) Main Shaft

The high, low, reverse and forward gears are installed on the main shaft through bushings. The synchromesh mechanism is used, so the rotation of gears which are about to be meshed are synchronized by operation of the shift arm. The high gear and low gear are always in mesh with the cluster gear, the reverse gear with the reverse idler gear, and the forward gear with the driven gear.

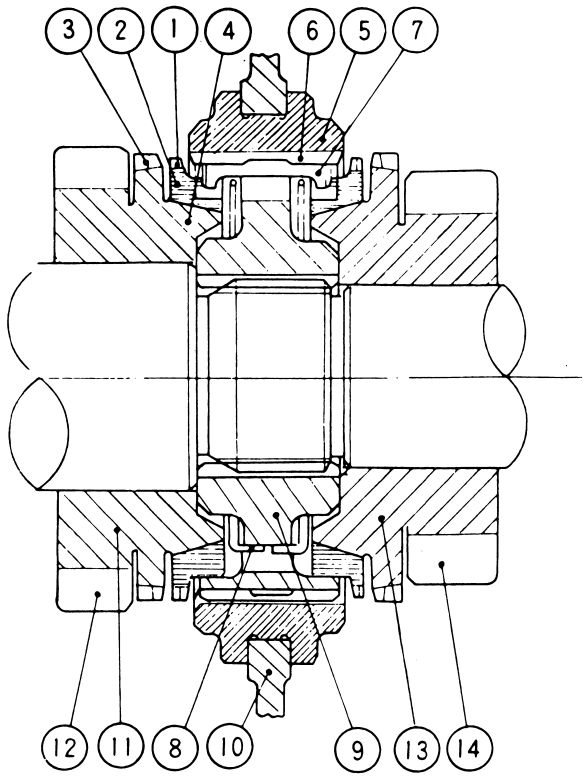
(4) Reverse Idler Shaft

Both ends of the reverse idler shaft are supported by the transmission case and positioned by a steel ball. The reverse idler gear is installed on this shaft through needle bearings, and is always in mesh with the reverse gear and driven gear.

(5) Shift Rod and Shift Arm

Two shift arms are used for performing the changeover in speed gears and direction gears respectively. At the shift rod mounting part of the shift arm, a ball and spring are assembled. The ball is designed to rest on the shift rod to secure gearshifting position.

(6) Synchromesh Mechanism



1. Gear teeth of block ring ②
2. Bloc ring
3. Dog teeth of gear ⑪
4. Synchronizing cone
5. Sleeve
6. Spline of sleeve ⑤
7. Insert
8. Ring spring
9. Clutch hub
10. Shift arm
11. Constant-mesh gear
12. Gear teeth of gear ⑪
13. Constant-mesh gear
14. Gear teeth of gear ⑬

Fig. 5-2 Synchromesh Mechanism

The synchromesh mechanism consists primarily of: (1) synchronizing cones, (2) block rings and (3) inserts.

(1) **Synchronizing Cone**: This meshes with the gear ⑪ through spline, and has a male cone friction surface and the dog teeth ③ which are engaged with the sleeve spline ⑥.

(2) **Block Ring**: This has a female cone friction surface which is the mating surface of the male friction surface of the synchronizing cone ④, and it also has three notches arranged on the circumference to position on the index

position together with the sleeve spline ⑥ as well as the gear ① to press the block ring to the cone friction surface in an axial direction through the sleeve spline ⑥

(3) **Insert**: The center projection of the insert is fitted in the inner annular groove provided in the spline ⑥ of the sleeve ⑤ and forced against the inner side of the sleeve spline ⑥ by the ring spring ⑧ so that an initial load is created to guide the block ring ② to the index position.

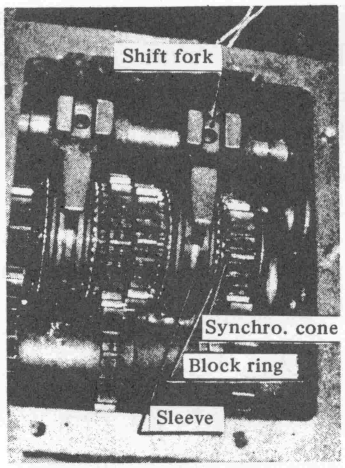


Fig. 5-3

The operation of the synchromesh mechanism has the following six steps from the neutral position to the completion of meshing. In the explanation given below, the gear ⑪ in Fig. 5-2 is regarded as a gear to be synchronized.

1st Step (See Fig. 5-4)

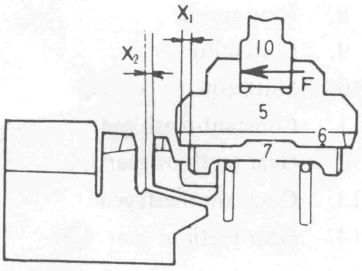


Fig. 5-4 (In Neutral)

When force F is applied on the change lever, it is transmitted to the sleeve ⑤ through the shift arm, so that the sleeve ⑤ and insert ⑦ are shifted in an axial direction by X_1 and X_2 respectively. In this case the center projection of the insert ⑦ is fitted in the annular groove of the sleeve spline ⑥.

2nd Step (See Fig. 5-5)

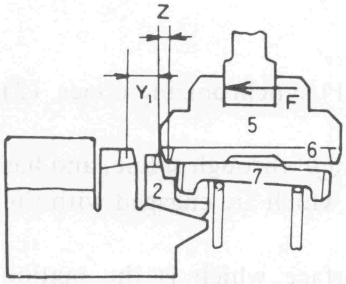


Fig. 5-5

When the clearances X_1 and X_2 have been filled, a force is applied to the insert ⑦, block ring ② and cone friction surface since the insert ⑦ goes out of the annular groove of the sleeve spline ⑥. This force is a function of the contacting angle formed by the center projection of the insert ⑦ and the inner annular groove of sleeve spline and the clamping force of the ring spring ⑧ forcing the insert ⑦ to the inside of the sleeve ⑤. The sleeve ⑤ is shifted by this force by a clearance Z.

3rd Step (See Fig 5-6)

The following figures 5-6, 5-7, 5-8, and 5-9 are the mechanism viewed from the top.

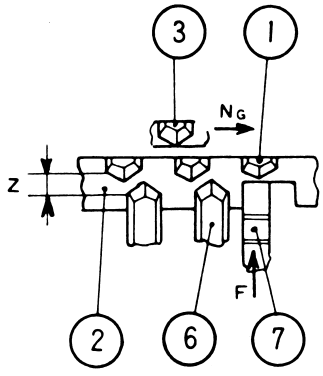


Fig. 5-6

The force applied to the block ring ② through the insert ⑦ creates friction force on the cone friction surface. This force allows the one end of the block ring notch to get in contact with the side face of the insert as shown in Fig. 5-6 (The position occupied by the block ring teeth ① and sleeve spline ⑥ is called an index position.

4th Step (See Fig. 5-7)

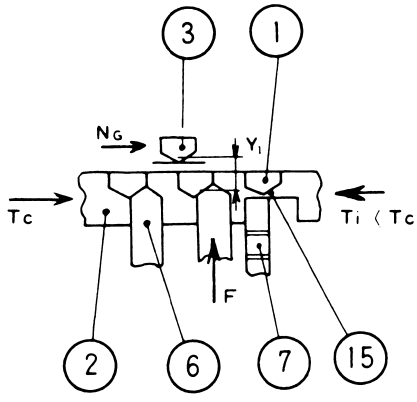


Fig. 5-7 Synchronization

When the block ring ② is brought into the 3rd step position, the sleeve ⑤ shifts by a clearance Z so that the chamer ⑮ of the tooth ① of the block ring ② comes into contact with the chamfer of the sleeve spline ⑥. At this time, the cone torque T_c necessary for synchronization is created on the cone friction surface, causing practically synchronization.

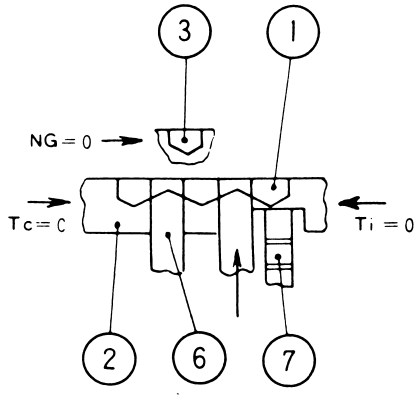


Fig 5-8 Synchronization Completed

When the relative speed of the synchronized constant-mesh gear ⑪ and sleeve ⑤ has become zero, completing synchronization, the cone torque T_c becomes also zero.At this time, as T_i is smaller than T_c, the block ring ②shifts in the peripheral direction to allow the sleeve spline ⑥ between the tooth ①. At this moment, the synchronization is completed, so that the block ring ② is free of external force and brought into an idle state. The sleeve spline ⑥ can, accordingly, pass between the tooth ① of the block ring ② freely.

6th Step (See Fig. 5-8 & 5-9)

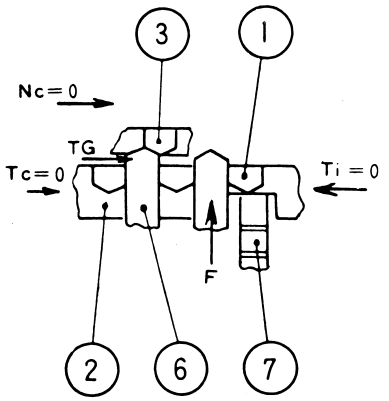


Fig. 5-9

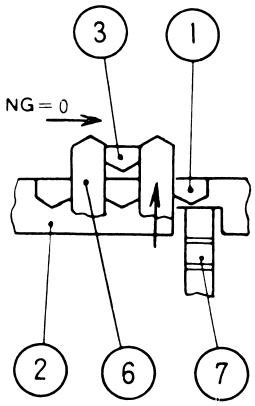


Fig. 5-10

When the synchronization has been completed, the sleeve spline ⑥ passes across the block ring ②, shifting by a clearance Y_1 indicated in Fig. 5-7, so that the chamfer of the sleeve spline ⑥ comes into contact with the chamfer of the dog tooth ③ of the gear ⑪. (See Fig. 5-9.) Due to contact of chamfers, torque T_G acts on the dog tooth ③ to pass the sleeve spline ⑥ so that the gear ⑪ shifts in the peripheral direction. This allows the sleeve spline ⑥ to pass between the dog tooth ③ of the gear ⑪, completing meshing. Power is carried through the shaft, clutch hub ⑨, sleeve ⑤ and dog tooth ③. Thus, the gearshifting operation is accomplished.

POWER FLOW

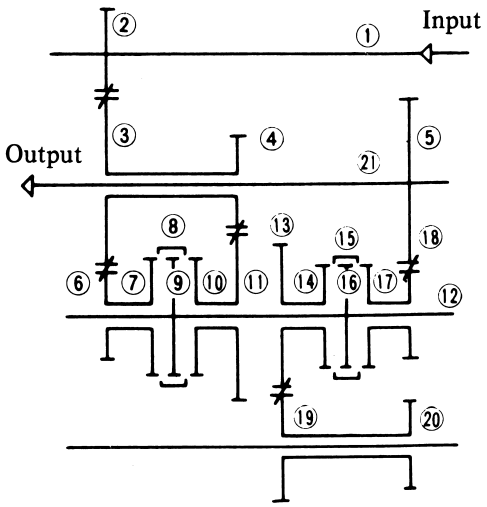


Fig. 5-11

1. Main drive shaft
2. Input gear
3. Cluster gear
4. Cluster gear
5. Driven gear
6. High gear
7. Synchronizing cone
8. Sleeve
9. Clutch hub
10. Synchronizing cone
11. Low gear
12. Main shaft
13. Reverse gear
14. Synchronizing cone
15. Sleeve
16. Clutch hub
17. Synchronizing cone
18. Forward gear
19. Reverse idler gear
20. Reverse idler gear
21. Output shaft

[In Neutral Position]

The power from the main drive shaft ① is transmitted through the cluster gears ③ and ④ always meshing with the input gear ② to the high gear ⑥ and low gear ⑪. But, the speed shift sleeve and directional shift sleeve are in the neutral position, the main shaft, driven gear, and output shaft are not rotated, so the power is not transmitted to the differential.

[Gear shifting]

When the change lever is shifted, the shift arms move the sleeves to allow gears to contact with the clutch hub and the main shaft. Power is transmitted in the following order: Main drive shaft, input gear, cluster gear, high gear or low gear, synchromesh mechanism, main shaft, synchromesh mechanism, reverse gear or forward gear, driven gear and output shaft.

Power Flow In Forward 1st Speed Gear Position:

①→②→③→④→⑪→⑩→⑧→⑨→⑫→⑯→⑮→⑰→⑱→⑤→㉑

Power Flow In Forward 2nd Speed Gear Position:

①→②→③→⑥→⑦→⑧→⑨→⑫→⑯→⑮→⑰→⑱→⑤→㉑

Power Folw In Reverse 1st Speed Gear Position:

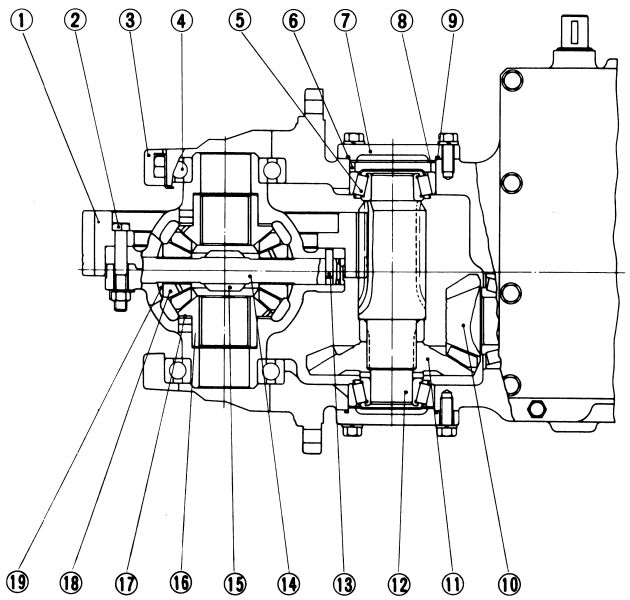
①→②→③→④→⑪→⑩→⑧→⑨→⑫→⑯→⑮→⑭→⑬→⑲→⑳→⑤→㉑

Power Flow In Reverse 2nd Speed Gear Position:

①→②→③→⑥→⑦→⑧→⑨→⑫→⑯→⑮→⑭→⑬→⑲→⑳→⑤→㉑

5-1-2 REDUCTION GEAR

The reduction gear is located in front of the transmission case. This device reduces speeds and multiplies torque transmitted from the output shaft of the transmission and imparts it to the differential. The reduction gear consists primarily of an output shaft gear mounted at the transmission side, a spiral bevel gear, and a final pinion gear shaft. The spiral bevel gear is installed on the final pinion gear shaft through spline. The final pinion gear shaft is supported in taper roller bearings at both ends. Several shims are installed between the case and bearing cover to adjust backlash.



1. Ring gear
2. Reamer bolt
3. Cap
4. Ball bearing
5. Tapered roller bearing
6. Spacer
7. Cap
8. Shim
9. "O"-ring
10. Output gear
11. Spiral bevel gear
12. Reduction gear
13. Pin
14. Pinion shaft
15. Pinion shaft
16. Side gear
17. Thrust washer
18. Pinion gear
19. Thrust washer

Fig. 5-12 Reduction Gear & Differential

5-1-3 DIFFERENTIAL

The differential is fitted to the rear case (reduction gear case) by ball bearings with bearing caps and covered with the axle housing. The cross case of the differential is of the split type containing two side gears and four pinion gears. The thrust plate is installed between the cross case and each gear according to the backlash. The pinion gear is supported by the pinion shaft, which is secured to the cross case with a knock pin. The ring gear is installed on the circumference of the cross case with reamer bolts. The drive shaft is fitted into the spline part of the side gear.

The rotation sent from the transmission through the reduction gear is further reduced and differentiated by this device to drive the drive shaft.

5-1-4 SHIFT ARM REPLACEMENT

We will give the shift arm replacement procedures of the transmission in the pages that follow. However, shift arm replacement is possible with the transmission on the machine. On-the-machine job is slightly different from the procedures covered in this booklet.

(1) Remove clutch cover mounting blots and detach clutch cover.

CAUTION:

Do not remove the lower bolt. Lightly loosen it.

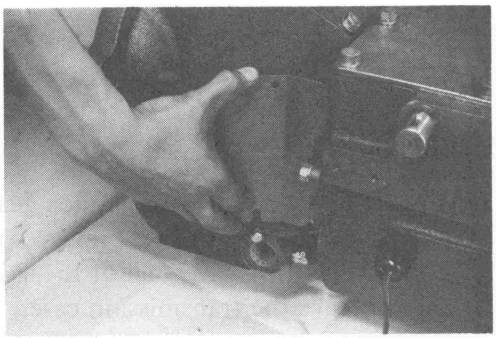


Fig. 5-13 Removing Clutch Cover

(2) Remove side cover mounting bolts.

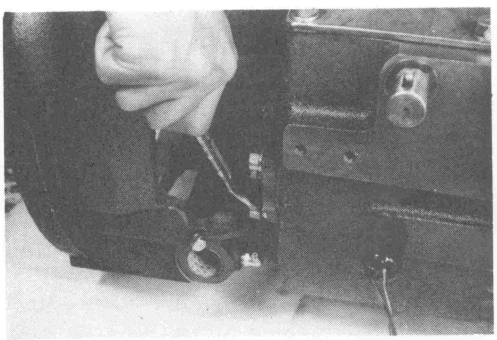


fig. 5-14 Removing Side Cover Bolts

(3) Pull out side cover a little.

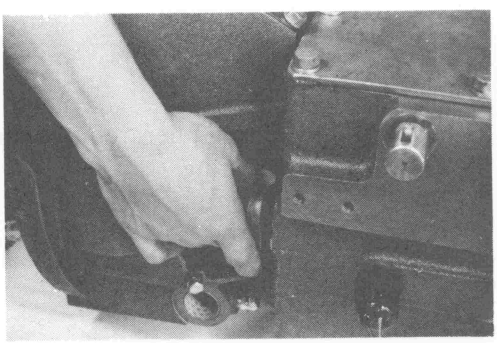


Fig. 5-15 Pulling Out Side Cover

(4) Remove case cover mounting bolts.

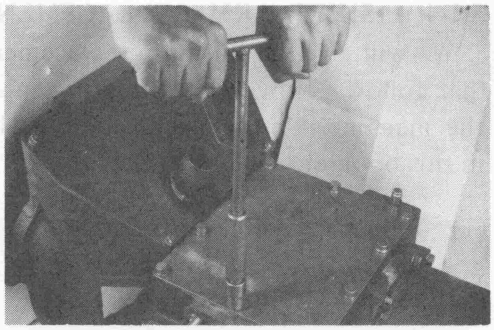


Fig. 5-16 Removing Case Cover Bolts

(5) See Fig 5-17. Perform a quick gear-shift from forward to reverse or vice versa to let the end of the shift lever leave the transmission case.

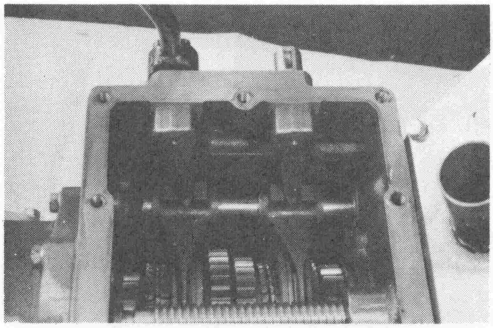


Fig. 5-17 Shift Lever

(6) Remove side cover, together with spacer and O-ring.

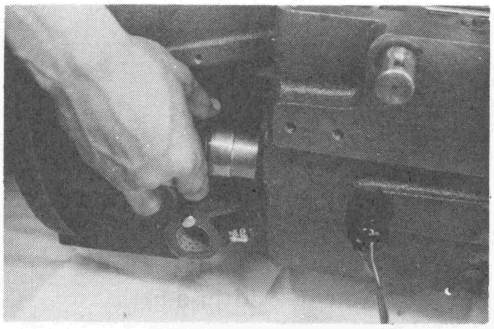


Fig. 5-18 Removing Side Cover

(7) Using a snap ring plier, remove shift lever lock snap ring.

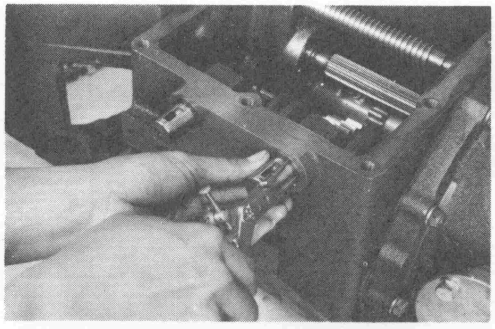


Fig. 5-19 Removing Snap Ring

(8) Remove spacer.

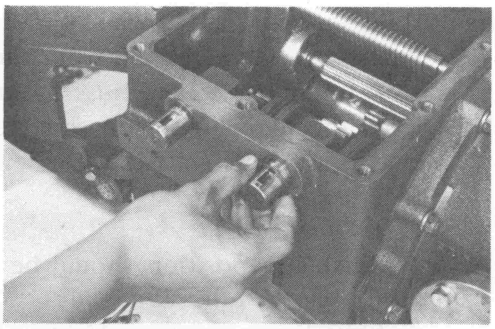


Fig. 5-20 Removing Spacer

(9) While attempting to turn the shift lever, lightly tap the shift lever end and remove the shift lever.

CAUTION:

Do not overtap the shift lever. Overtapping will cause the shift lever to get entangled with the shift arm and also may result in a damaged shift lever.

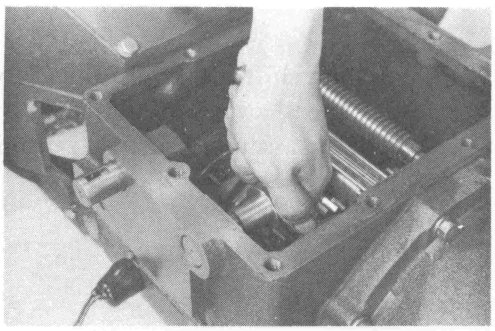


Fig. 5-21 Removing Shift Lever

(10) Remove shift arm, together with shift lever.

CAUTION:

Before removing shift arm, make sure of the shifting position of the shift arm.

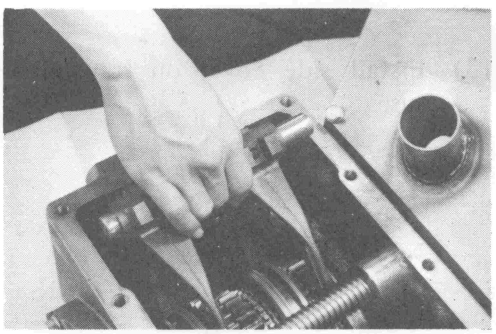


Fig. 5-22 Removing Shift Arm

5-1-5 REASSEMBLY OF SHIFT ARM

Reassembly of the shift arm is performed in the reverse order of disassembly. Observe the following requirements.

- Reassembly should be performed in a clean orderly area and due care exercised to prevent the possibility of dirt and foreign matter entering the unit.
- Check for undue wear of each part. Replace with new one if worn excessively.
- In general, all packings and O-rings should be replaced with new ones.

(1) Hold shift arm as shown in Fig. 23. Put spring and steel ball from shift arm upper hole and insert shift lever then tap lightly on shift rod end to assemble shift arm and lever together.

CAUTION:

- Shift arm position should be as it was when disassembled.
- Shift levers have á symmetrical design.

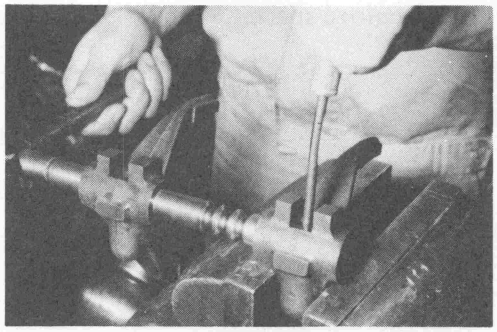


Fig. 5-23 Joining Shift Lever in Shift Arm

(2) Matching shift arms with the grooves of the sleeve, put the shift arm and lever assembly in the transmission case.

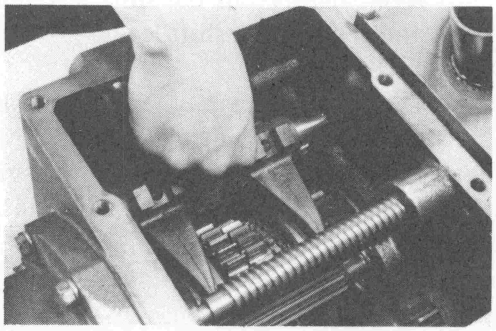


Fig. 5-24 Installing Shift Arm and Lever Ass'y

(3) Install side cover on transmission case.

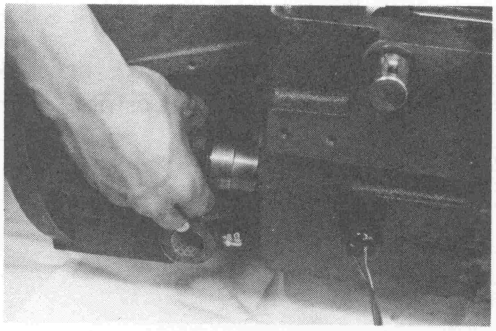


Fig. 5-25 Installing Side Cover

(4) When installing side cover, care should be paid to position of shift lever.

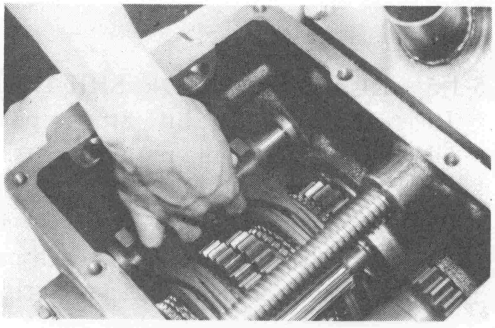


Fig. 5-26 Installing Side Cover

(5) First loosen set bolt a little. Tighten two side cover mounting bolts to the specified torque of 2.9-4.7 kg.m (21-34ft. lbs).

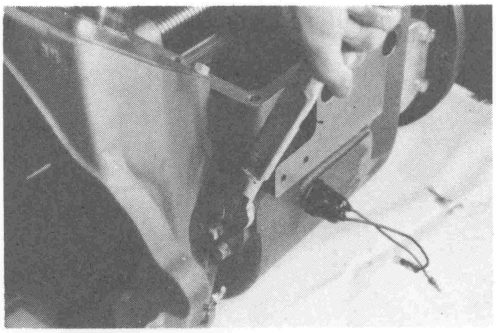


Fig. 5-27 Mounting Side Cover

(6) Make certain that shift rod end (differential side) rests in transmission case hole.
Then tighten set bolt to the specified torque of 0.8-1.8 kg•m (5.8-13 ft• lbs).

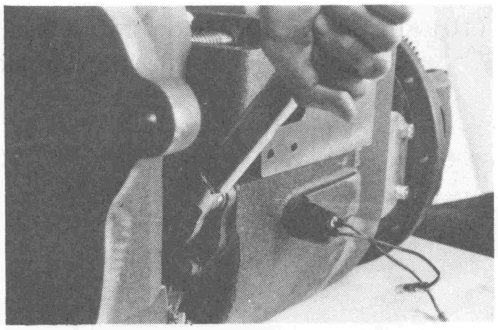


Fig. 5-28 Tightenin Lock Bolts

(7) Tighten lock-nut to the specified torque of 1.4 to 2.4 kg•m (10-17 • lbs).

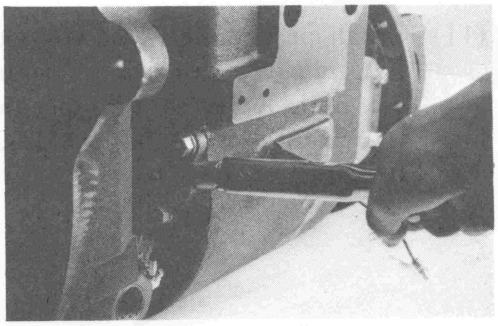


Fig. 5-29 Tightening Lock Nuts

(8) Install shift levers, with O-rings, to the transmission case.

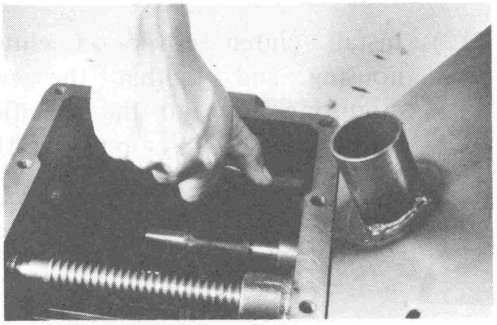


Fig. 5-30

(9) Install spacers on each shift levers.

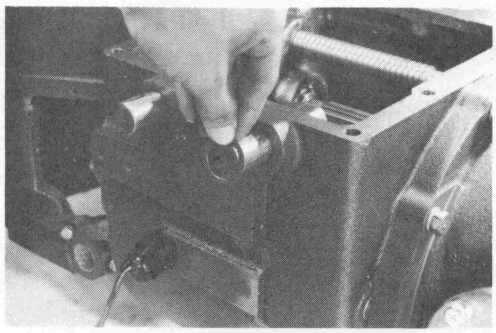


Fig. 5-31 Installing Spacers

(10) Install snap rings on shift levers to secure them to the transmission case.

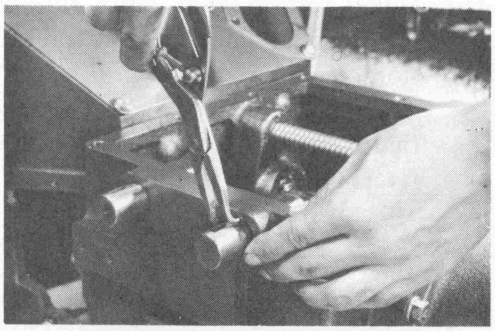


Fig. 5-32 Installing Snap Ring

(11) Install packing and case cover on transmission case and tighten mounting bolts to the specified torque of 2.1-3.5 kg·m (15-25 ft· lbs).

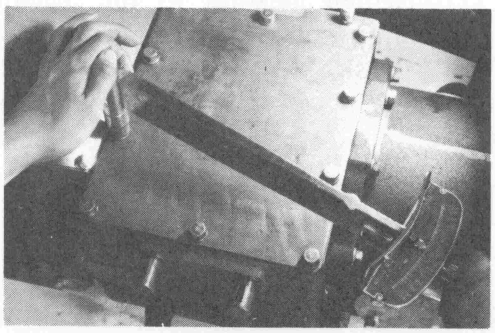


Fig. 5-33 Installing Case Cover

(12) Install clutch cover on clutch housing and tighten the two mounting bolts to the specified torque of 0.4-0.8 kg· m (3-6 ft·lbs).

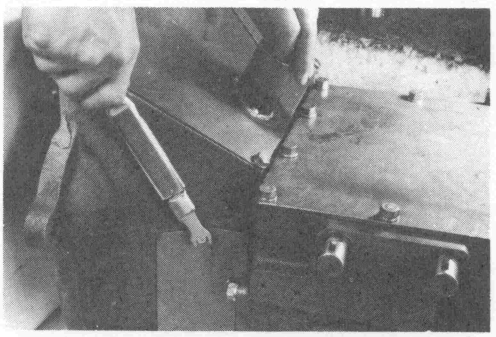


Fig. 5-34 Installing Clutch Cover

6. TORQUE CONVERTER TRANSMISSION

	2 – 2.5 ton	2.8 – 3.0 ton
Torque Converter:		
Type:	3-element, 1-stage, 2-phase type	←
Stall Torque Ratio:	3	←
Set Pressure:	5 – 6 kg/cm^2 (71.1 – 85.3 psi)	←
Charging pump:		
Type:	Crescent type	Gear type
Discharge:	16.6 cc/rev [6.1 US gal/min]	32 ℓ/min [8.5 US gal/min]
Transmission:		
Type:	Power-shift type	←
Gear Ratio:		
Fwd:	1.455	1.35
Rev:	1.455	1.35
Clutch Facing, O.D. x I.D. x Thickness	125 mm x 81 mm x 2.7 mm (4.92 in x 3.2 in x 0.1 in)	←
Clutch Facing Surface Area:	71 cm^2 (8 pcs.)	←
	11 in^2 (8 pcs.)	←
Set Pressure:	10 – 13 kg/cm^2 (142 – 185 psi)	11–14 (156–199 psi)
Weight:	165 kg (364 lbs)	←
Oil Amount:	6.7 ℓ (1.8 US gal)	3.5 ℓ (0.9 US gal)
Oil to be Used:	Torque converter oil	←

6-1 GENERAL DESCRIPTION

The torque converter type transmission mounted on this machine is a superb combination device of the torque converter and power-shift transmission, which has been developed by T C M and has excellent features as follows:

(1) An inching valve provides the machine with improved inching performance. Due to this valve, the lift tuck is allowed to perform inching operation regardless of whether the engine is at low RPM or at high RPM, and when the truck is started up.

(2) As clutch plates, four steel plates and the same number of composite plates subjected to special treatment are provided so that improved durability can be ensured.

(3) A free wheel installed in the torque converter improves transmission efficiency. (3-element, 1-stage, 2-phase type)

(4) The torque converter circuit is given an inline filter to improve its durability.

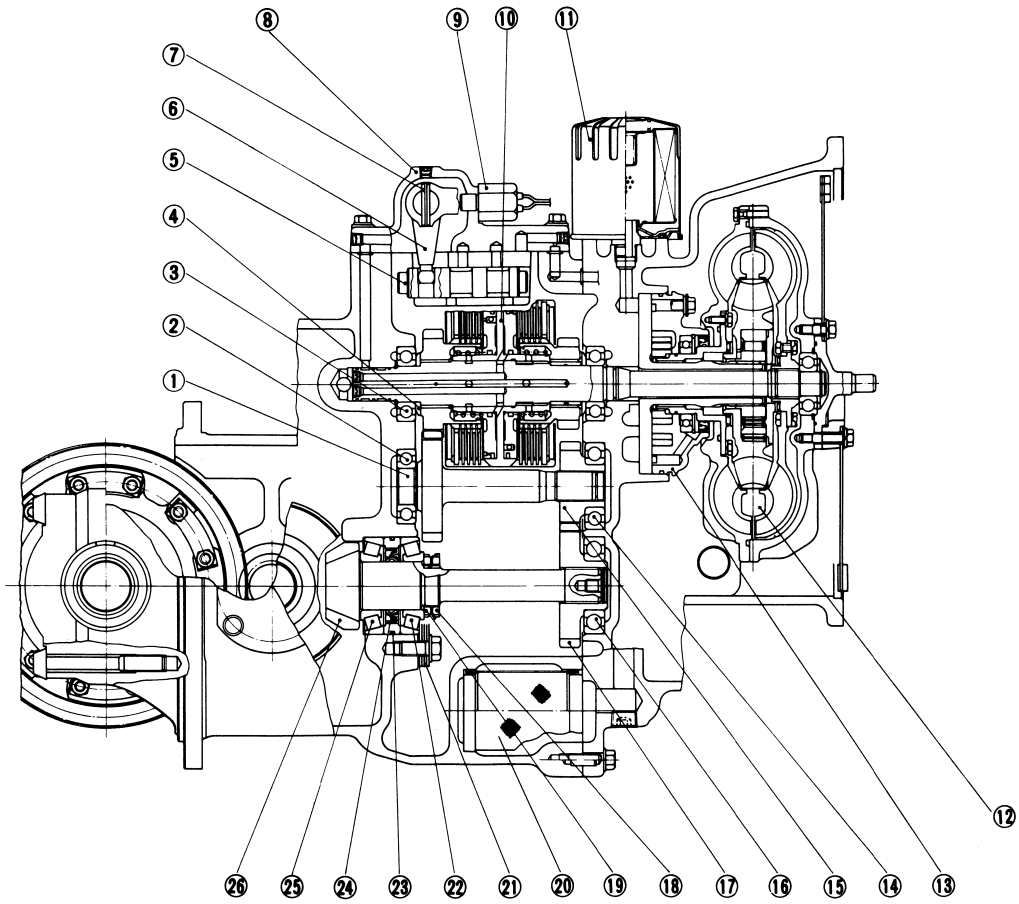


Fig. 6-1 Torque Converter Type Transmission (2 – 2.5 ton)

1. Reverse gear
2. Ball bearing
3. Ball bearing
4. Thrust washer
5. Selector hub
6. Arm
7. Roll pin
8. Case cover
9. Switch
10. Hydraulic clutch
11. Oil filter
12. Torque converter
13. Charging pump
14. Ball bearing
15. Reverse idle gear
16. Ball bearing
17. Output gear
18. Lock nut
19. Bearing nut
20. Strainer
21. Shim
22. Tapered roller bearing
23. "O"-ring
24. Oil seal
25. Tapered roller bearing
26. Output shaft

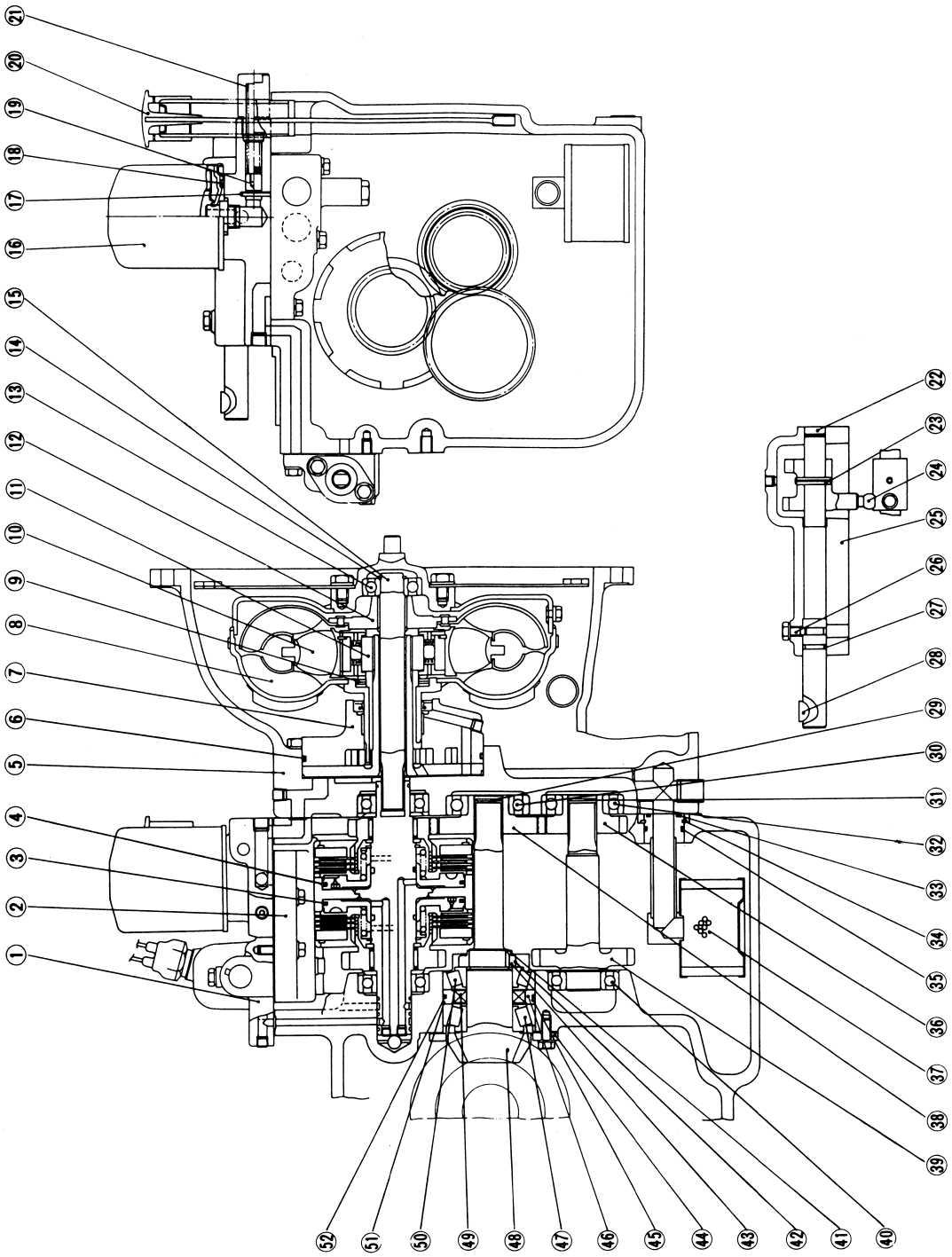


Fig. 6-2 Torque Converter Type Transmission (2.8 – 3.0 ton)

1. Cover
2. Control lever
3. Hydraulic clutch
4. Hydraulic clutch
5. Torque converter housing
6. "O"-ring
7. Charging pump
8. Pump wheel
9. Thrust bearing
10. Stator
11. Free wheel
12. Turbine wheel
13. Ball bearing
14. Snap ring
15. Turbine shaft
16. Line filter
17. Roll pin
18. "O"-ring
19. Relief
20. Lever gauge
21. Spring
22. Plug
23. Roll pin
24. Shift lever
25. Shaft
26. Stopper bolt
27. "O"-ring
28. Key
29. Snap ring
30. Ball bearing
31. Snap ring
32. Ball bearing
33. "O"-ring
34. Snap ring
35. "O"-ring
36. Reverse idler gear
37. Strainer
38. Outer gear
39. Reverse gear
40. Ball bearing
41. Lock nut
42. Lock washer
43. Bearing nut
44. Bearing retainer
45. Shim
46. Spacer
47. Taper roller bearing
48. Output shaft
49. Oil seal
50. Taper roller bearing
51. Oil seal retainer
52. "O"-ring

6-1-1. TORQUE CONVERTER

The torque converter consists primarily of a pump wheel connected to the input shaft, a turbine wheel connected to the output shaft, and a stator wheel fixed to the housing. (3-element, 1-stage type).

The pump wheel is rotated by the drive shaft and fluid is strongly ejected along the row of pump wheel vanes under centrifugal force. (In this state mechanical energy is converted into kinetic energy.) The ejected fluid flows in the row of turbine wheel vanes to transmit torque to the output shaft. The direction of fluid leaving the turbine wheel is changed by the stator wheel so that it flows into the pump wheel at proper angle. At this time, reaction torque pushing the stator is created so that the output torque exceeds the input torque by this reaction torque. As the rotational speed of the turbine wheel increases and gets close to the input rotational speed, angle change of the fluid is reduced and the output shaft torque is decreased. Finally fluid flows into the row of the stator vanes in the reverse direction, causing reverse reaction torque. As a result of this, the output shaft torque becomes smaller than the input shaft torque. To prevent this condition, a free wheel (one-way clutch) is provided at the stator section to allow the stator wheel to rotate freely when reaction torque acts in the reverse direction.

The output torque is kept equal to the input torque so that highly effective operation is ensured. Since the phase of torque transmission is converted by the mechanical means (clutch), this type of torque convertion is called 2-phase type, which ensures smooth and effective operation.

The torque converter section of the torque converter transmission (2 – 2.5 ton) is connected through the flex plate to the engine flywheel and designed to rotate as the engine rotates. Inside the torque converter case are turbine wheel, pump wheel, and stator wheel. The inner space is filled with torque converter oil. A drive gear is splined to the pump wheel to drive the charging pump. The turbine wheel is splined to the main shaft to transmit power to the wet type multiple disk clutch.

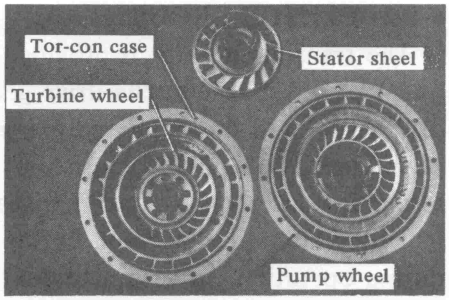
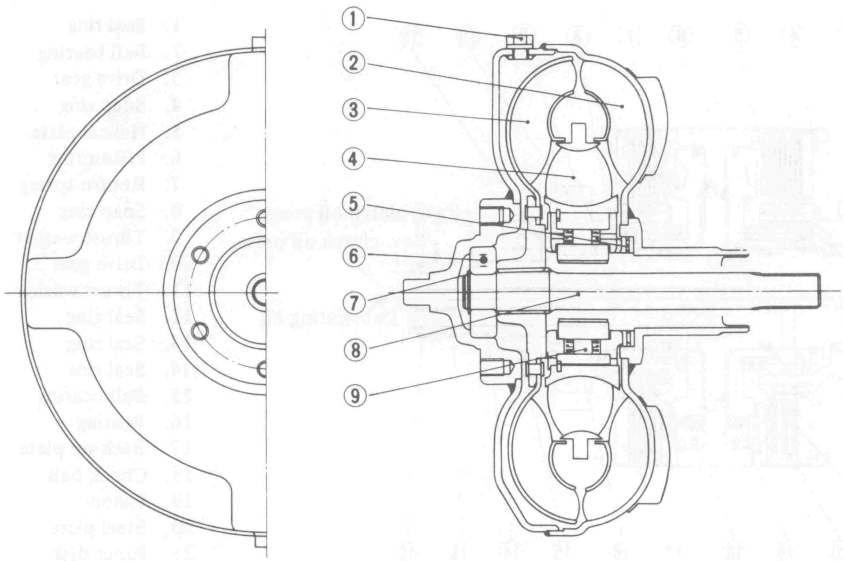


Fig. 6-3 Torque Converter (2 – 2.5 ton)

The torque converter section of the automatic transmission (2.8 – 3.0 ton) is connected through the flex plate to the engine flywheel and designed to always rotate as the engine rotates. Inside the torque converter case are a turbine wheel, pump wheel, and stator wheel. The inner space is filed with torque converter oil. A drive gear is splined to the pump wheel to drive the charging pump. The turbine wheel is splined to the main shaft to transmit power to the wet type multiple disk clutch.



1. Drain plug
2. Pump wheel
3. Turbine wheel
4. Stator wheel
5. Thrust bearing
6. Ball bearing
7. Snap ring
8. Turbine shaft
9. Free wheel

Fig. 6-4 Torque Converter (2.8 – 3.0 ton)

6-1-2 CLUTCH GROUPS

The transmission side is provided with wet type multiple disk clutch groups which operate hydraulically. The drive gear at the forward clutch side is in mesh with the driven gear and the counter drive gear at reverse clutch side with the counter shaft gear. One clutch group consists of four sintered plates and four clutch steel plates assembled alternately, and a piston. The piston is provided with slipper seal on its outer circumference and O-ring on the inner circumference to insure oil sealing during operation. In neutral state, the piston rod is located at the position where the multiple disk clutch is released by a coil spring. The clutch surface is always lubricated with oil from the oil cooler to prevent burn and wear. When oil pressure affects the piston, the alternately arranged composite plates and steel plates are locked, forming an aggregated clutch group, so that power from torque converter is transmitted to the drive gear.

Accordingly, the order of power transmission of the torque converter transmission is as follow:

Turbine wheel → main shaft → clutch drum → steel plate → composite plate → forward or reverse gear → output shaft.

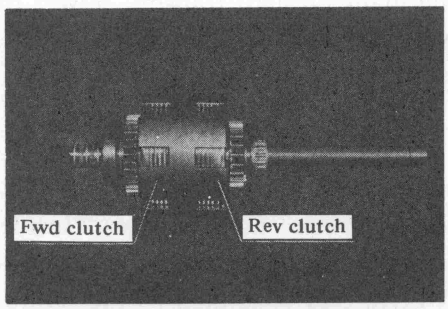
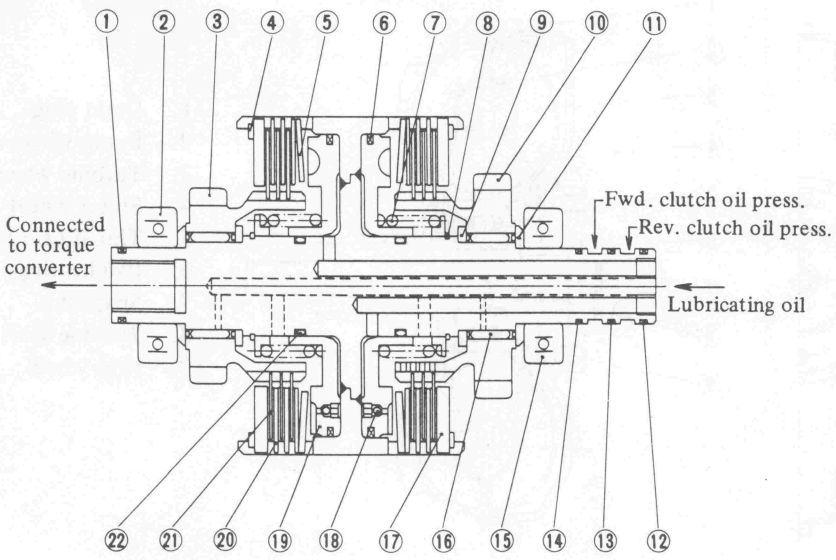


Fig. 6-5 Hydraulic Clutch (2.0 – 2.5 ton)



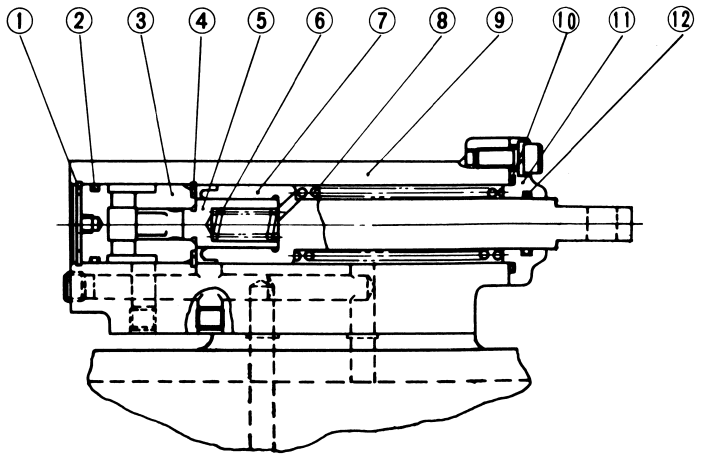
1. Seal ring
2. Ball bearing
3. Drive gear
4. Snap ring
5. Helical plate
6. Piston ring
7. Return spring
8. Snap ring
9. Thrust washer
10. Drive gear
11. Thrust washer
12. Seal ring
13. Seal ring
14. Seal ring
15. Ball bearing
16. Bearing
17. Back-up plate
18. Check ball
19. Piston
20. Steel plate
21. Paper disk
22. "O"-ring

Fig. 6-6 Hydraulic Clutch (2.8 – 3.0 ton)

6-1-3 CONTROL VALVE, RELIEF VALVE AND INCHING VALVE

The control valve is installed on the case cover of the transmission. In the valve body are installed a change spool.

The inching valve is located at the side of transmission case, and its spool is connected to the link of the brake pedal. When the brake pedal is depressed the spool moves to the right to temporarily drop clutch oil pressure, thereby disengaging the clutch.



1. Snap ring
2. O-ring
3. Inching spool
4. Snap ring
5. Inching plunger
6. Inching spool
7. Inching rod
8. Spring
9. Valve body
10. O-ring
11. Cap
12. O-ring

Fig. 6-7 Inching Valve (2 – 2.5 ton)

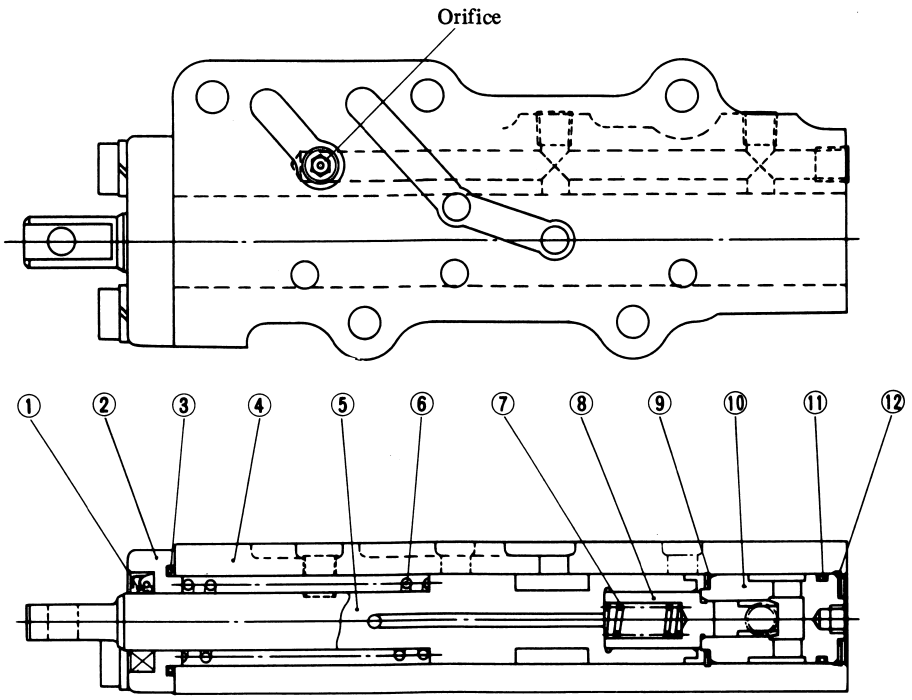


Fig. 6-8 Inching Valve (2.8 – 3.0 ton)

1. Oil seal
2. Cover
3. O-ring
4. Body
5. Rod
6. Spring
7. Spring
8. Valve
9. Snap ring
10. Valve seat
11. O-ring
12. Snap ring

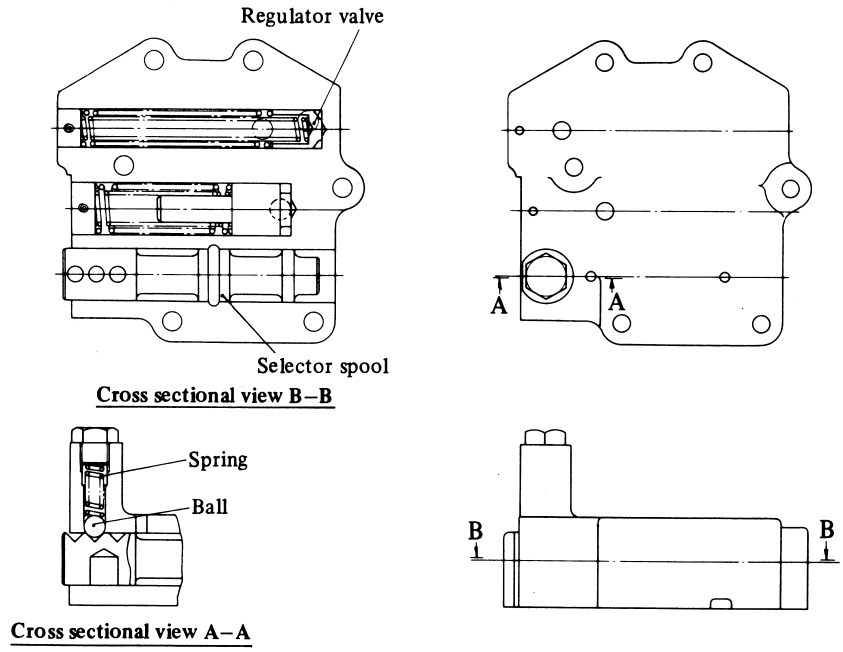


Fig. 6-9 Control Valve

6-1-4 CHARGING PUMP

The charging pump is a gear type and is installed in the stator support. It feeds oil to the torque converter, hydraulic clutches and transmission to lubricate them. The charging pump consists of drive gear, driven gear, case and cover. See Fig. 6-10.

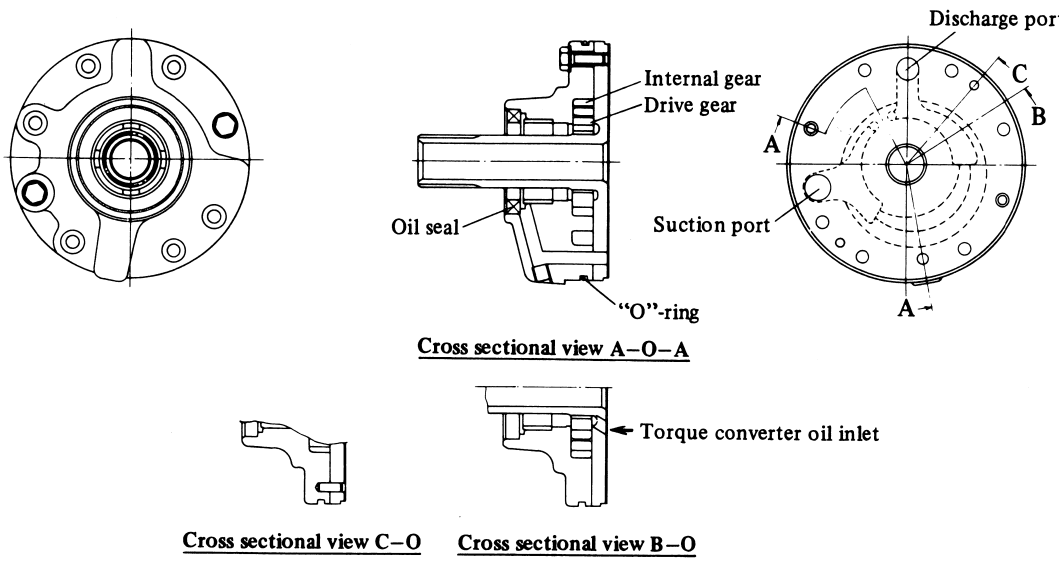


Fig. 6-10 Charging Pump

6-1-5 TRANSMISSION CASE

The transmission case containing forward and reverse clutch groups serves also as an oil tank. At the bottom of the case double-net type oil strainer (Mesh: #150 and #30) is installed to clean oil which is sucked up to the charging pump. The oil level gauge and inline filter are installed on the top of the transmission case.

6-1-6 HYDRAULIC CIRCULATION

When the engine is started and the charging pump is driven by the pump drive gear fitted to the pump wheel boss, torque converter oil is drawn from the oil tank (transmission case) through the strainer by the pump and routed to the control valve under pressure. The oil from the chariging pump is divided by the flow divider into two portions: One for clutch operation and the other for charging the converter, and lubrication circuit.

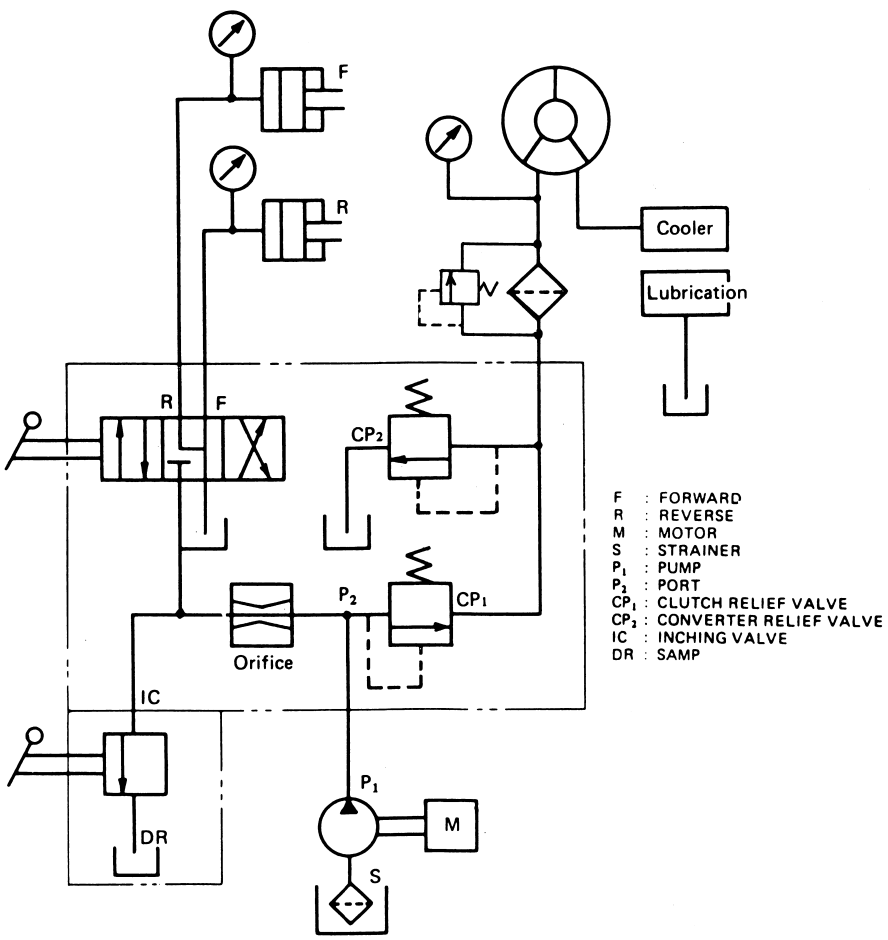


Fig. 6-11 Oil Circulation Diagram (2.0 – 2.5 ton)

The oil necessary for clutch operation flows into the relief valve where its pressure is set to 10 to 13 kg/cm^2 (142 to 185 psi). [2.8 to 3.0 ton: 12 to 14 kg/cm^2] It is further directed to the inching valve and selector valve. On the other hand, the oil for the converter is pressure regulated to 5 to 6 kg/cm^2 (71.1-85.3 psi) by the converter relief valve and flows into the converter wheel section, and after being cooled by the oil cooler it lubricates clutch groups and then returns to the oil tank. While the change spool is in the neutral position, the passage from the selector valve to the clutch remains closed so that the clutch relief valve is opened by the force of the clutch operation oil to allow the oil to join the oil for charging the converter. When the change spool is placed in the forward or reverse position, the circuits from the selector valve to either the forward or the reverse clutch are connected to allow the respective clutches to operate. While one of the two clutch groups is in motion, the composite plates and steel plates in the other clutch group rotate freely. To prevent seizure of plates, these plates are lubricated by oil led from the oil cooler. When the inching valve is operated by brake pedal force, the major portion of oil led to the clutch is drained through the inching valve to the transmission. The oil for the converter circulates in the same manner as in the case of neutral.

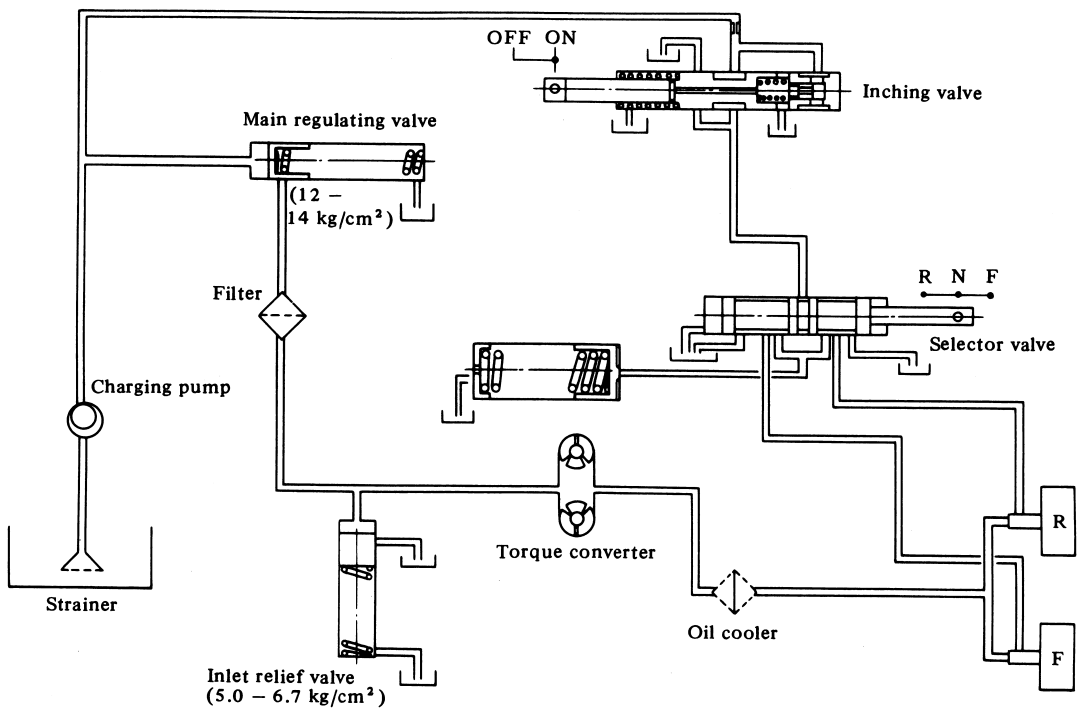


Fig. 6-12 Oil Circulation Schematic Diagram (2.8 – 3.0 ton)

6-1-7 REDUCTION GEAR AND DIFFERENTIAL

Since the reduction gear and differential for the torque converter type truck are the same as those for the clutch type, refer to the preceding chapter "Transmission and Differential"

6-1-8 TOWING DISABLED TRUCK

When towing a disabled truck provided with the torque converter transmission by another machine, be sure to follow the requirements given below:

(1) The axle shaft should be disconnected from the front wheel hub.

(2) The change lever should be in neutral position.

These means are necessary to prevent seizure of transmission and clutch. With the torque converter pump being in rest, normal lubrication is not effected and rotation from the front wheels is transmitted to the transmission gears and multi-disk clutch, resluting in seizure.

6-1-9. OIL PRESSURE CHECK PORTS

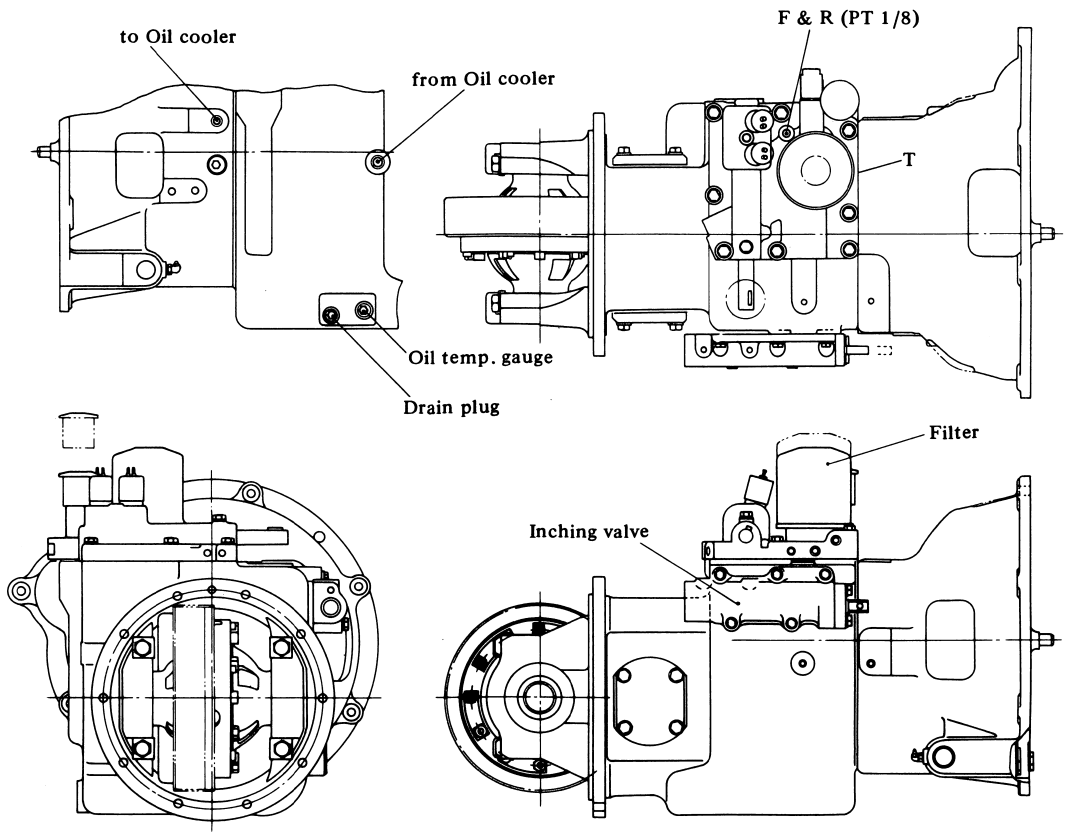


Fig. 6-13 Oil Pressure Check Ports

7. FRONT AXLE

Type:		Front two-wheel drive, frame-fixed, full floating
Tire size:	2 – 2.5 ton:	2 x 7.00 – 12 – 12PR (J-lug)
	2.8 – 3.0 ton:	28 x 9 – 15 – 12PR (I)
Rim size:	2 – 2.5 ton:	2 x 5.00 S – 12 D
	2.8 – 3.0 ton:	7.00T x 15
Tire inflation pressure:		7 kg/cm^2 (100 psi)

7-1 GENERAL DESCRIPTION

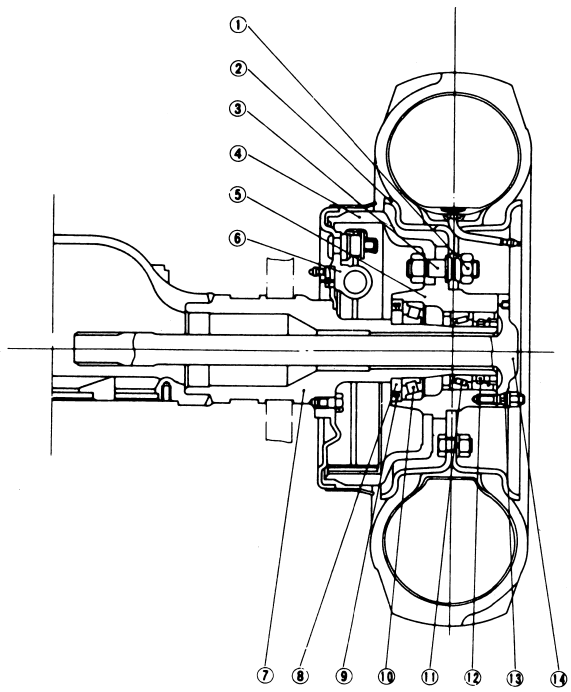
The front axle is a full-floating type and cast into one piece construction consisting of wheel hub, wheel brake, and housing as shown in Fig. 7-3. The tire is installed on the wheel hub with studs and nuts.

7-1-1 WHEEL HUB

The wheel hub receives power through the differential and drive shaft and rotates the front wheel. The drive shaft is not subjected to load because the hub is installed in the axle housing by two taper roller bearings, so the drive shaft transmits only rotational force to the hub. Inside the hub, oil seals are provided to prevent the entrance of water or dust, or the leakage of grease.

7-1-2 TIRE AND RIM

The tire assembly is installed on a split type rim consisting of tire, tube, and flap. The tube is given a valve by which air is fed.



1. Wheel Nut
2. Rim
3. Hub bolt
4. Brake drum
5. Hub
6. Wheel cylinder
7. Axle housing
8. Oil seal retainer
9. Oil seal
10. Taper roller bearing
11. Taper roller bearing
12. Bearing nut
13. Dowel
14. Drive shaft

Fig. 7-1 Front Axle (2 – 2.5 ton)

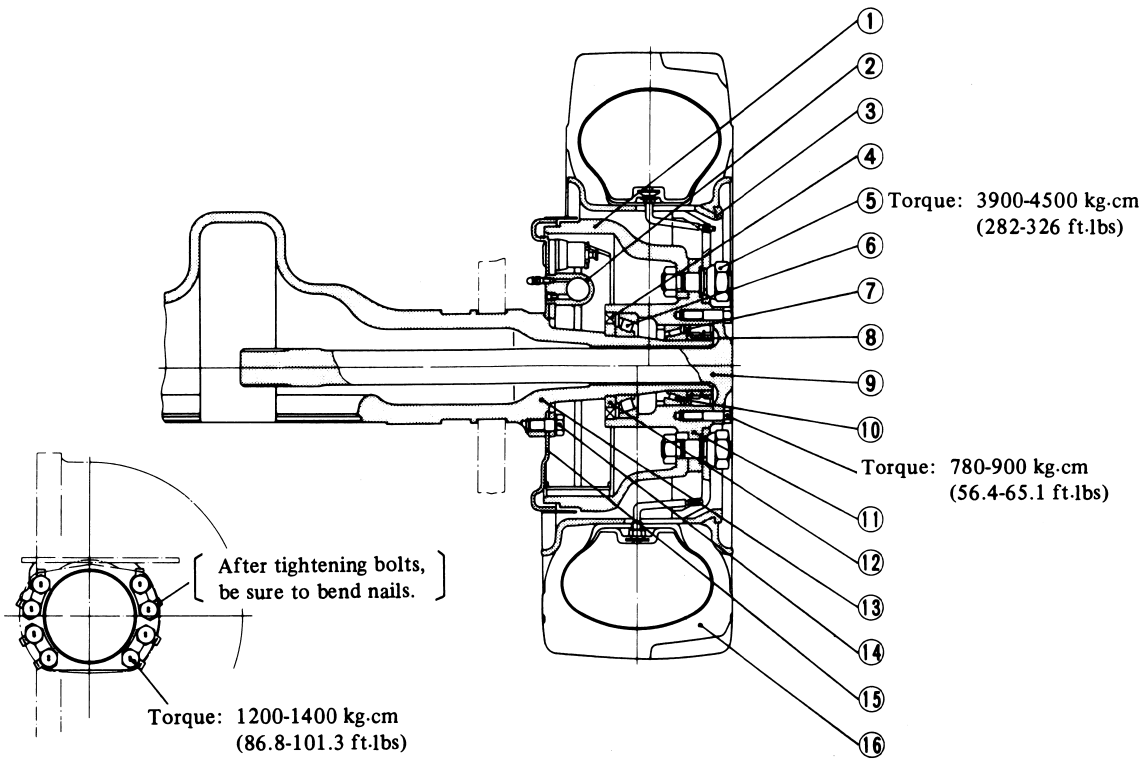


Fig. 7-2 Front Axle (2.8 – 3.0 ton)

1. Brake drum
2. Wheel cylinder
3. Rim
4. Oil seal
5. Wheel nut
6. Taper roller bearing
7. Oil seal
8. Bearing nut
9. Axle shaft
10. Taper roller bearing
11. Wheel hub
12. Retainer
13. Axle housing
14. Bolt
15. Wheel brake
16. Tire

7-1-3 FRONT AXLE MAINTENANCE

Reinstallation of the front axle hub should be performed with care given below.

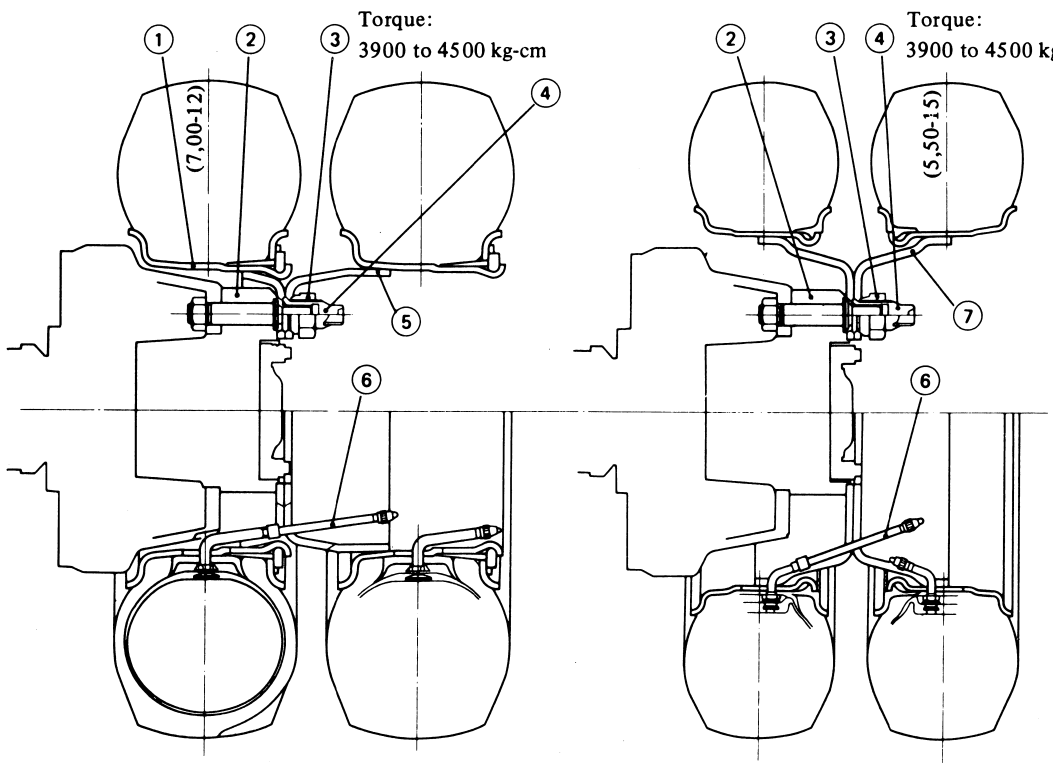
(1) Apply grease on the rollers of the taper roller bearing.

(2) Since the bearing nut is designated to give pre-load to the taper roller bearing, it should be tightened so that hub rolling torque may be 100-300 kg· cm (7.23-21.69 ft.lbs)

(3) Tighten the drive shaft mounting nuts to the torque of 6-7 kg.m (43-50 ft.lbs).

(4) Tighten the wheel mounting nuts to the torque of 3900 - 4500 kg.cm (28.2 - 32.5 ft. lbs).

(5) Tighten the brake drum mounting nuts to the torque of 3.9 - 4.5 kg.m (28.2 -32.5 ft. lbs).



(a) Special double tire

(b) Standard double tire

Fig. 7-3

1. Inside rim
2. Hub
3. Inner hub nut
4. Outer hub nut
5. Outside rim
6. Extension
7. Rim

8. STEERING SYSTEM

	2.0 – 2.5 ton	2.8 – 3.0 ton
Steering System:		
Type:	Rear-wheel steering with power steering	←
Power Steering:		
Type:	Semi-integral type	←
Steering Gear:		
Type:	Recirculating ball & nut type	←
Name:		
Reduction Ratio:	20 : 1	←
Pitman Arm Working Angle:	75°	←
Steer Handwheel Dia.:	380 mm (15 in)	←
Power Cylinder:		
Type:	Double acting	←
Cylinder Bore:	50 mm (1.97 in)	60 mm (2.36 in)
O.D. of Cylinder Rod:	22 mm (0.87 in)	25 mm (0.98 in)
Stroke:	230 mm (9.1 in)	←
Flow Divider:		
Set Pressure:	90 kg/cm^2 (1280 psi)	70 kg/cm^2 (995.6 psi)
Set Flow Rate:	11 ℓ/min (2.9 US gal)	14 ℓ/min (3.64 US gal)

8-1 GENERAL DESCRIPTION

The steering system is a rear-wheel steering type with a hydraulic booster, which consists of steering gear, power cylinder and flow divider.

8-1-1 STEERING GEAR

The steering gear is a semi-integral type being compsed of a recirculation ball/nut worm and a steering valve.

The worm and ball nut are both hardened and ground precisely to have the grooves (internal/external) of special cross section. The steel balls are packed in the screw grooves between the ball nut and worm to convert sliding friction force of the worm and ball nut into rolling friction force of steel balls, providing smooth, easy action of the steer handwheel. As the steering shaft turns, the steel balls roll between the worm and ball nut until they reach the end of the ball nut, then return to the inlet of the ball nut, guided through the ball tube. At the bottom of the steering gear case is installed a steering control valve to control oil flow for the steering cylinder.

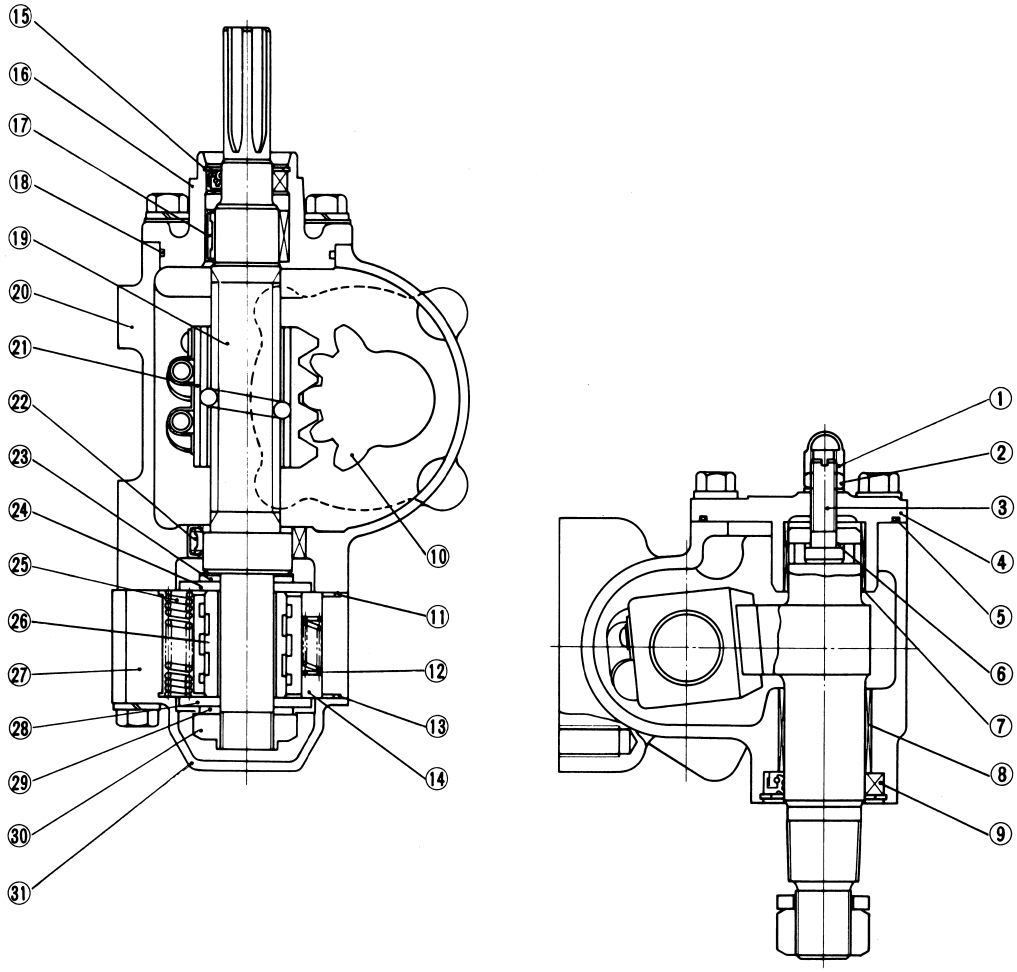


Fig. 8-1 Power Steering

1. Cap nut
2. Lock nut
3. Adjustor
4. Cover
5. "O"-ring
6. Shim
7. Bushing
8. Bushing
9. Oil seal
10. Sector shaft
11. "O"-ring
12. Spring
13. "O"-ring
14. Reaction piston
15. Oil seal
16. Cover
17. Needle bearing
18. "O"-ring
19. Steering shaft
20. Gear case
21. Ball nut
22. Bearing
23. Thrust bearing
24. Guide
25. Spring
26. Spool
27. Body
28. Guide
29. Thrust bearing
30. Nut
31. Cover

The sector shaft, supported by the coil bushings fitted to the side cover and gear box, is installed on the worm at a right angle. At one end of the side cover is the adjusting screw to adjust engagement of the ball nut rack and sector gear. The other end is a tapered serration to which the pitman arm is installed with a nut.

The control valve consists of a valve housing, spool, spring and reaction piston. Grooves on the inner periphery of the valve housing and the outer periphery of the spool are used to control the oil flow. The spool is installed at the lower part of the steering shaft through a needle bearing with nuts.

(1) **Hydraulic Operation Principle** (See Fig. 8-2)

(a) Steer handwheel at straight position.
When the steer handwheel is in straight position, the control valve is in the neutral position by operation of centering springs (8) and (36) as shown in Fig. 8-2. In this case, the oil discharged from the hydrualic pump flows through the control valve into the tank, resulting in no pressure to be applied on the power cylinder.

(b) When the steer handwheel is turned left (See Fig. 8-3.)
When the steer handwheel is turned left, the pitman arm does not move if the steering force is small, due to resistance of the truck body applied on the pitman arm, (ball nut (41) is also locked), so that worm shaft (40) rotates counterclockwise moving in such a direction that the steering handwheel sinks (the center ring spring is contracted.)
With the movement of the worm shaft, the steering control valve is actuated to allow oil passages B and D to open and A and C to close so the oil flow route is determined. The pressure oil from the pump, thus, flows through oil passage B of the control valve to the power cylinder. Meanwhile, the oil discharged from the power cylinder passes through oil passage D of the control valve, returning to the tank. When the steer handwheel is turned and held, the worm shaft is pushed back by the centering spring, placing the spool in the neutral position so the control valve is put in "Straight Travel" position as shown in Fig. 8-2.

(c) When the steer handwheel is turned right (See Fig. 8-4.)
The steering operation principle is the same as in Step (b): As the handwheel is turned right, the worm shaft is pushed upwards to close oil passages B and D and open oil passages A and C, thus allowing the truck to turn right.

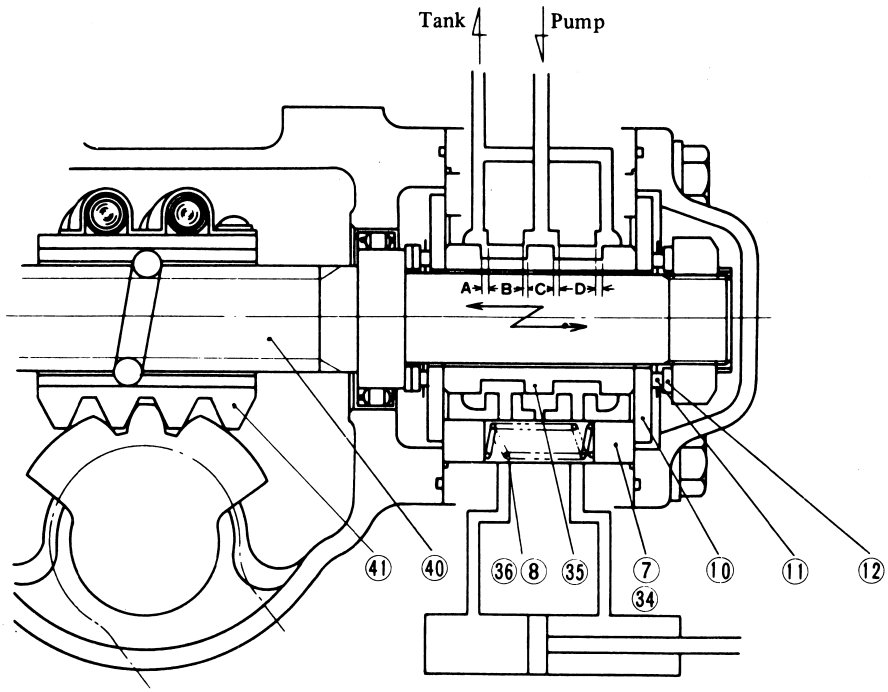


Fig. 8-2 Control Valve in Neutral

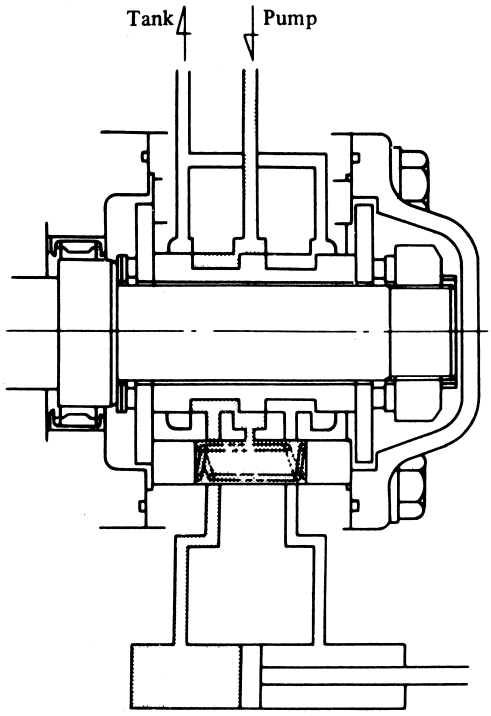


Fig. 8-3. Steer Handwheel Turned Left

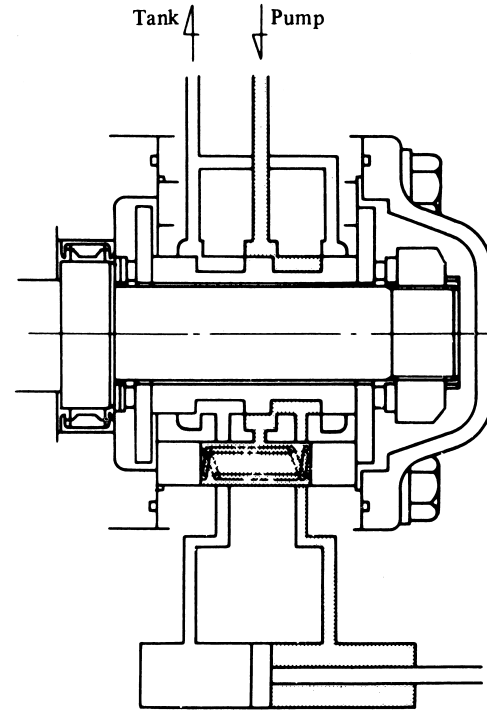


Fig. 8-4. Steer Handwheel Turned Right

8-1-2 STEERING CYLINDER

The steering cylinder is a double-acting piston type. The cylinder tail end ball joint is fitted to the frame while the piston rod end to the center arm of rear axle. At the cylinder tube tail side, a ball joint is screwed in and locked with lock nut. The cylinder tube is furnished with a box at the piston rod side to support the piston rod. The oil led from the power steering control valve flows through the inlet port into the steering cylinder to move the piston rod and steer the truck.

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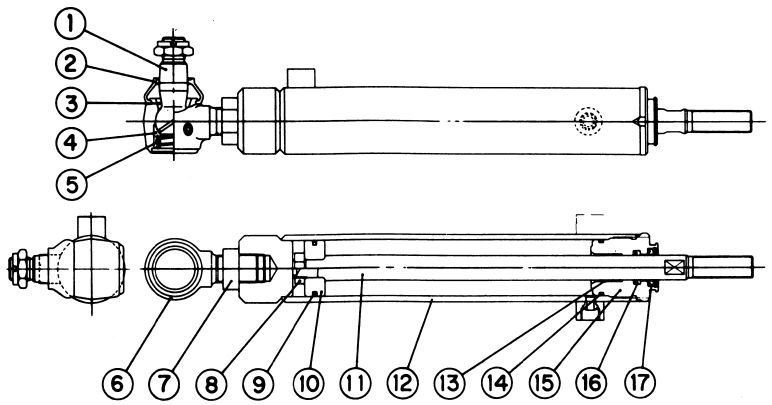


Fig. 8-5 Power Cylinder

1. Ball stud	4. Ball seat	7. Lock nut	10. Piston	13. Bushing	16. Packing
2. Boot	5. Spring	8. Nut	11. Piston rod	14. "O"-ring	17. Wiper
3. Ball seat	6. Ball joint	9. Packing	12. Cylinder	15. Cylinder cap	

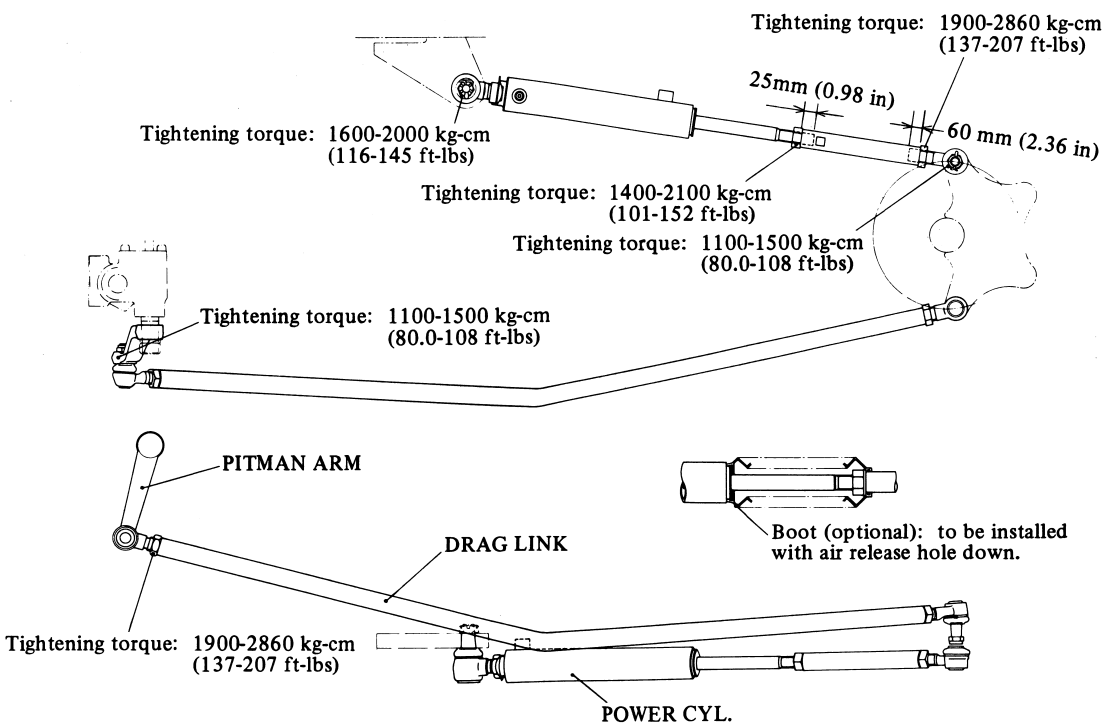


Fig. 8-6 Steering Linkage

8-2 MAINTENANCE

8-2-1 DISASSEMBLY OF STEERING GEAR

(1) Hold the steering gear box by a vice.

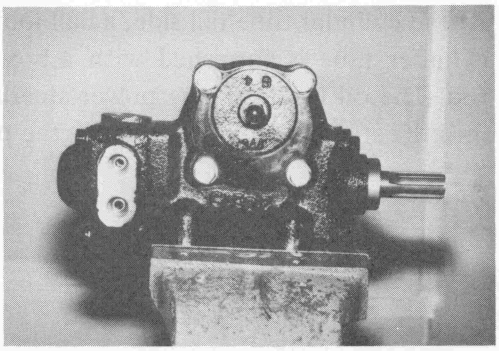


Fig. 8-7

(2) Remove the box nut, packing, and hex. nuts. Then remove the hex. head bolts and turn the adjusting screw clockwise to remove the side cover.

(3) Remove the adjusting screw and the adjusting screw shim installed in the sector shaft.

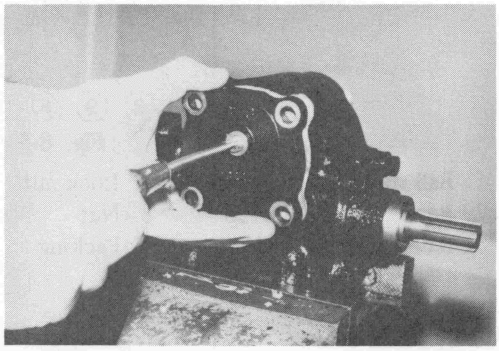


Fig. 8-8

(4) Turn the worm so that the sector shaft and ball nut are positioned as shown in Fig. 8-9. Tap the serration side of the sector shaft by hand lightly to remove the same.

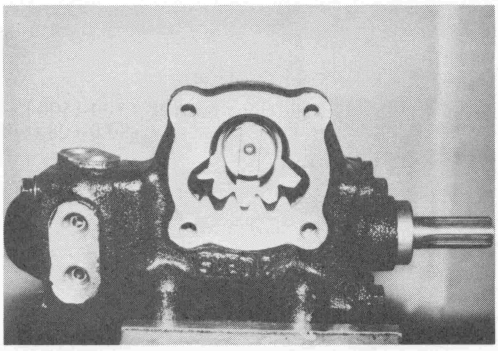


Fig. 8-9

(5) Loosen the three hex. head bolts and remove the front cover.

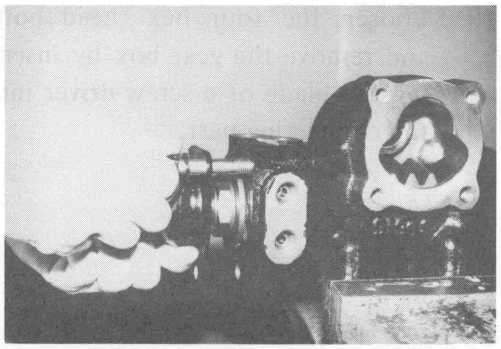
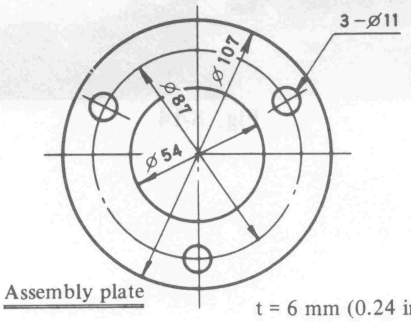


Fig. 8-10

(6) Set up the assembly plate and raise the two calked parts of the lock nut with a screw-driver and remove the lock nut.



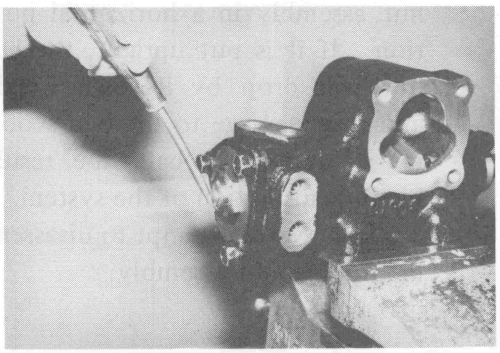


Fig. 8-11

(7) Remove the assembly plate and then the guide ring, needle roller bearing, and guide ring.

(8) Using caution as not to drop reaction pistons and coil spring, remove the control valve.
NOTE: Use caution as not to lose the component parts.

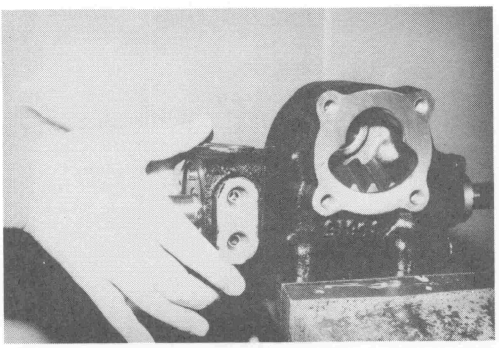


Fig. 8-12

(9) Loosen the four hex. head bolts and remove the gear box by inserting the blade of a screw-driver into the connecting part.

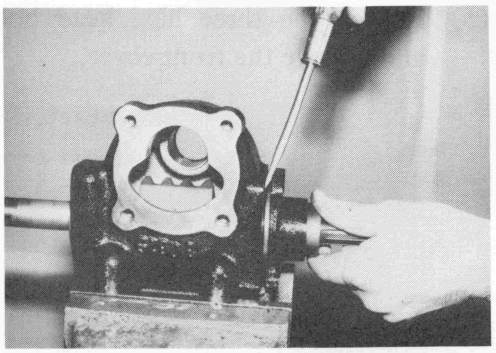


Fig. 8-13

(10) Remove the ball nut assembly from the gear box. Always keep the ball nut assembly in a horizontal position. If it is put upright, the ball nut will drop by its own weight and give damage to the ball scooping section of the ball tube, resulting in malfunction of the system.
NOTE: Never attempt to disassemble the ball nut assembly.

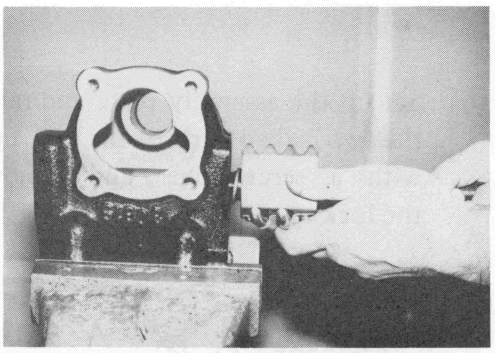


Fig. 8-14

8-2-2 INSPECTION

(1) Replace all rubber parts including "O"-rings with new ones.

(2) Move the balls and nuts to see if they are operating smoothly. If not, clean by moving them in cleaning solvent. When the ball groove is defective, replace as a ball/nut assembly.

8-2-3 REASSEMBLY

(1) Install the spool in the valve housing, pointing the smaller chamfered part of the inner diameter toward the mark "P" on the housing.

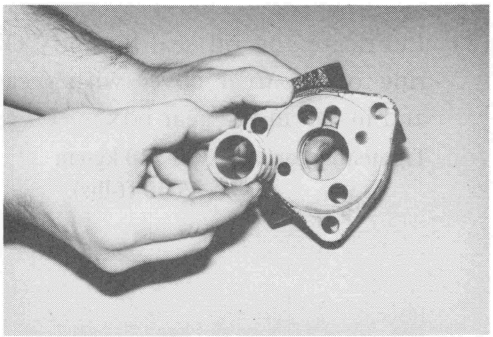


Fig. 8-15

(2) Install the reaction piston and centering spring.

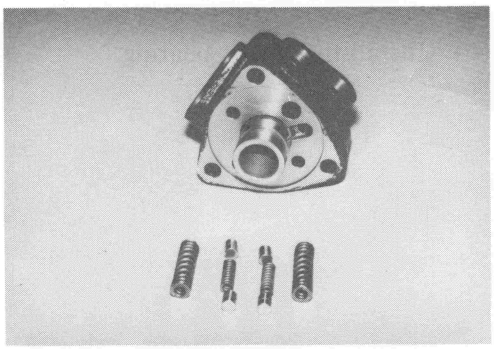


Fig. 8-16

(3) Lubricate the oil seal lip of the gear box with grease.

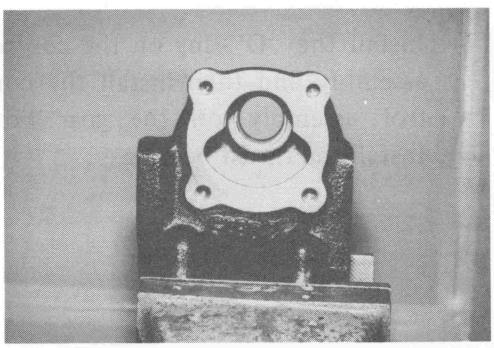


Fig. 8-17

(4) Put the ball/nut assembly in the gear box with its rack up.

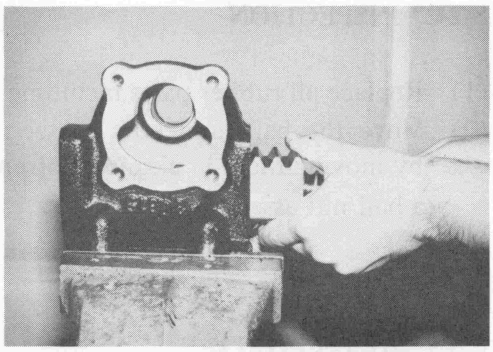


Fig. 8-18

(5) Lubricate the oil seal lip and "O"-ring of the rear cover with grease and install in the gear box.

Tightening torque: 350-540 kg-cm (25-40 ft-lbs)

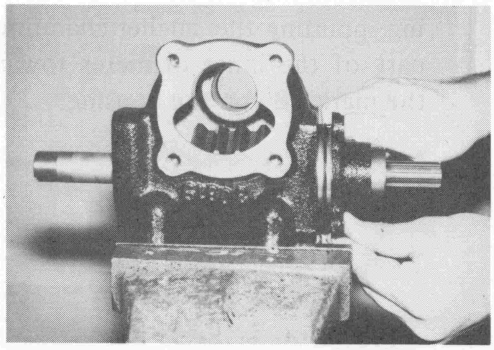


Fig. 8-19

(6) Install the thrust bearing.

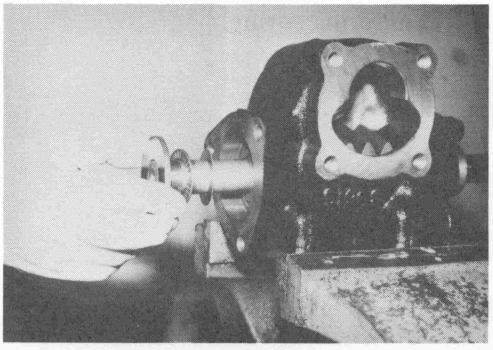


Fig. 8-20

(7) Install the "O"-ring on the control assembly and then install the control assembly on the gear box. Install the thrust bearing.

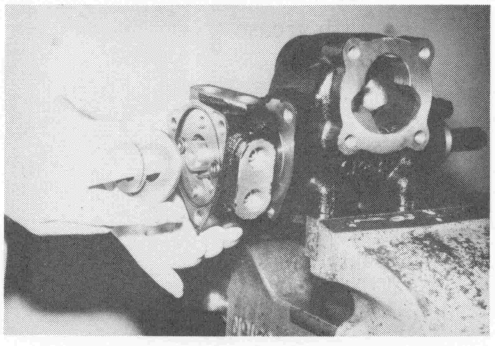


Fig. 8-21

(8) Set the jig on the control valve.

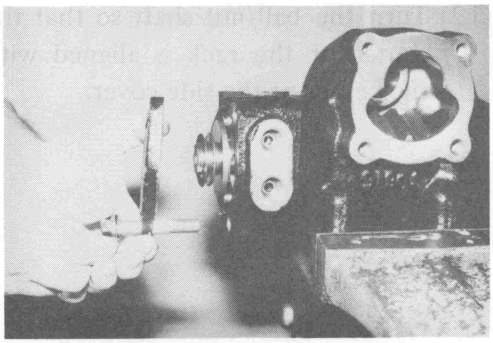


Fig. 8-22

(9) Turn the steering shaft counterclockwise up to the stop. Then hand tighten the nut and mark across the calking groove and the nut position at the steering shaft end. Turn off the nut once and retighten to see if the matchmarks are in line with each other. If they are aligned correctly, give an additional turn of about 5° to the nut. At this time the shaft torque should be less than 10 kg-cm (0.72 ft-lbs).

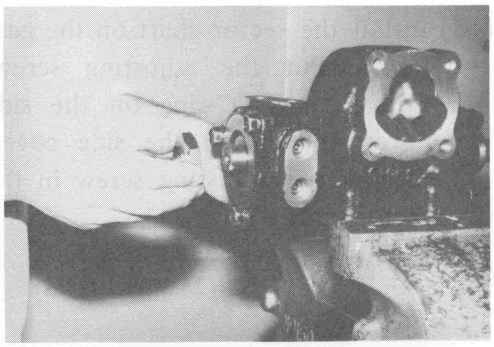


Fig. 8-23

(10) Stake the nut and remove the jig.

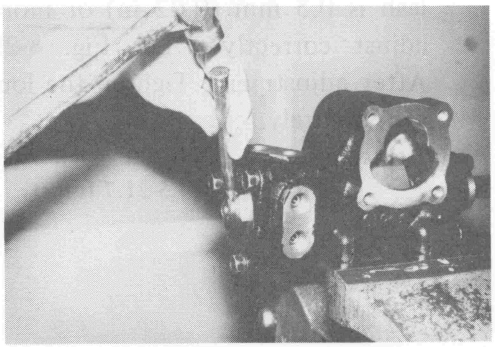


Fig. 8-24

(11) Install the front cover on the control valve.

Tightening torque: 380-580 kg-cm (27.5-42.0 ft-lbs)

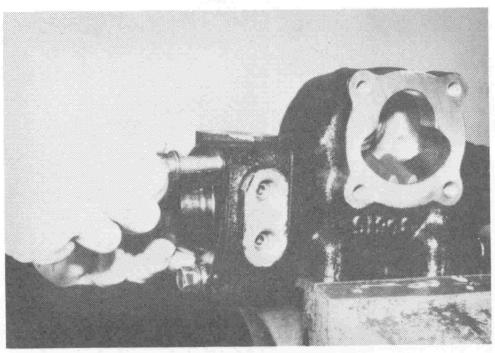


Fig. 8-25

(12) Turn the ball/nut shaft so that the center of the rack is aligned with the center of the side cover.

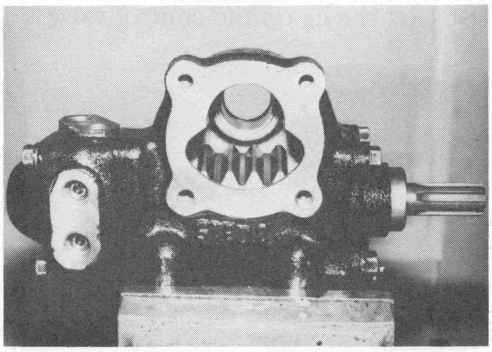


Fig. 8-26

(13) Install the sector shaft on the gear box. Put the adjusting screw, shims, and "O"-ring on the side cover and install the side cover, placing the adjusting screw in the sector shaft groove.

Tightening torque: 350-540 kg-cm (25.3-39.1 ft-lbs)

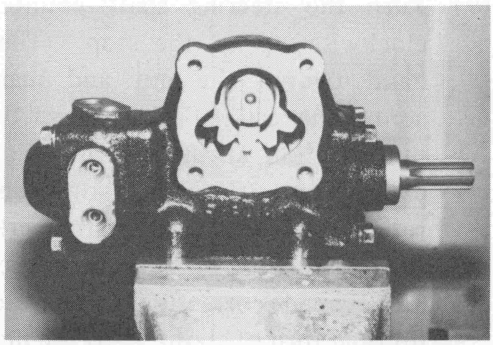


Fig. 8-27

(14) Measure the backlash between the sector shaft and rack. If the backlash is 0.5 mm (0.02 in) or more, adjust correctly. See Fig. 8-29. After adjustment, Tighten the lock nuts securely.

Tightening torque: 200-300 kg-cm (14.5-21.7 ft-lbs)

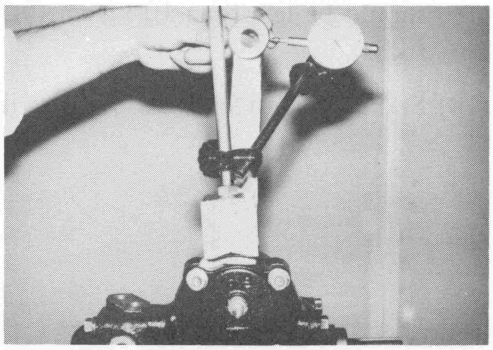


Fig. 8-28

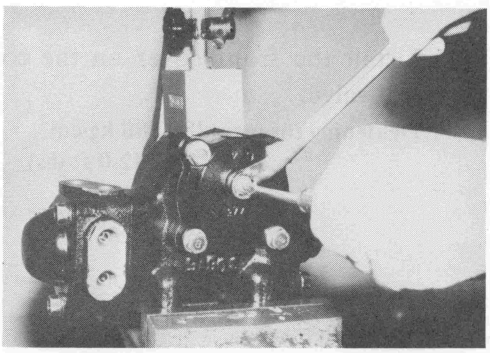


Fig. 8-29

8-2-4 AFTER-MOUNTING INSPECTION

(1) Turn the steering handwheel clockwise to the stop and remove your hand from the wheel to see if the wheel returns about 60° smoothly. Make a check on the counterclockwise rotation in the same manner.

(2) Check that the hydraulic piping is correctly arranged and that the hydraulic oil level in the reservoir is proper, and crank the engine.

(3) Jack up the rear wheels. Turn the steering wheel slowly clockwise and counterclockwise several times to bleed air from the hydraulic line and power cylinder. Check also that the wheel operates smoothly.

8-2-5 TROUBLESHOOTING GUIDE

Problem	Possible cause	Remedy
Handwheel won't turn	○ Defective or damaged pump	Replace.
	○ Relief valve sticking or damaged	Clean or replace.
	○ Control valve sticking, damaged or worn	Replace or repair.
	○ Damaged hose or joint, or clogged oil passage.	Replace or clean.
Hard steering wheel operation	○ Low oil level in oil tank	Add oil.
	○ Insufficient air bleeding	Air bleeding.
	○ Low pressure	See preceding item.
	○ Control valve sticking or damaged	Clean or replace.
Truck wanders or vibrates	○ Loose spool in control valve	Retighten nut.
	○ Control valve damaged or spring broken or deteriorated	Replace.
Abnormal noise	○ Low level of oil in oil tank	Add oil.
	○ Clogged suction pipe or filter	Clean or replace.
	○ Control valve sticking or damaged	Replace.
Oil leaks	○ Improperly-fitted or damaged "O"-ring or oil seal in piping or control valve	Replace.

9. REAR AXLE

Axle:		
Type:		Center-pin supported, Elliot type
Steering Angle:		
Inner wheel:		78°
Outer wheel:		54°
King Pin:		
Spacing:		810 mm (31.9 in)
Tilt:		7°
Swivel Radius:		50 mm (2.0 in)
Camber:		1°
Caster:		0°
Toe-in:		0 mm (0 in)
Trail:		0
Weight:		115 kg (254 lbs)
Wheel:		
Tire:	2.0 – 2.5 ton:	2 x 6.00 – 9 – 10PR (J-lug)
	2.8 – 3.0 ton:	2 x 6.50 – 10 – 10PR (I) J
Rim:	2.0 – 2.5 ton:	2 x 4.00 E – 9DT
	2.8 – 3.0 ton:	2 x 5.00F – 10
Inflation Pressure:		7.0 kg /cm^2 (100 psi)
Weight:		15 kg (33.1 lbs)

9-1 GENERAL DESCRIPTION

The rear axle is of the welded construction with a box-shaped cross section, consisting of an axle, center arm, tie rods and knuckles. The rear axle supports are push-fitted into the front and rear support pins of the axle body and bolted to the rear frame, so that the rear axle can be cradled around the support pins.

At each end of the axle is a knuckle, which turns right and left on the king pin. The rear wheel hub is installed on the knuckle spindle with two tapered roller bearings, and the wheel is installed on the hub with hub bolts and nuts. The king pin side tapered roller bearing has a single-side seal to secure grease between the hub and knuckle. The king pin and center arm have grease nipples through which grease is applied. So premature failure due to poor lubrication can be prevented.

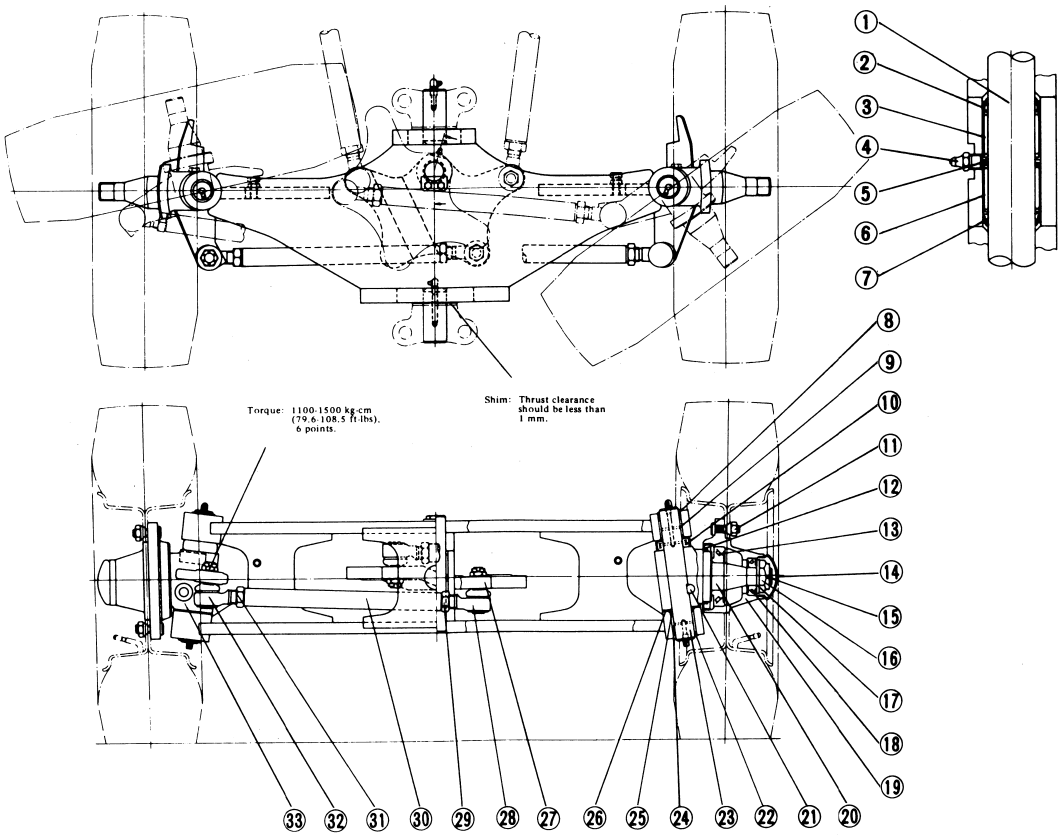


Fig. 9-1. Rear Axle

1. Center arm pin
2. Oil real
3. Needle bearing
4. Grease nipple
5. Spacer
6. Needle bearing
7. Oil seal
8. Oil seal
9. Needle bearing
10. Thrust bearing
11. Hub nut
12. Oil seal
13. Tapered roller bearing
14. Cap
15. Cotter pin
16. Castle nut
17. Washer
18. Tapered roller bearing
19. Hub
20. Knuckle (RH)
21. Lock pin
22. Oil seal
23. King pin
24. Needle bearing
25. O-ring
26. Shim
27. Center arm
28. Ball joint
29. Lock nut
30. Tie rod
31. Lock nut
32. Ball joint
33. Knucle (LH)

9-1-1 KNUCKLE AND KING PIN

The knuckles are of the Elliot type and installed between the upper and lower bosses on each end of the axle with a king pin, together with shims and thrust bearings. The king pin is locked to the knuckle with lock pin, and both ends are supported by bearings press-fitted to the axle boss. To seal grease for the needle bearings, oil seals are provided. The king pin is given a grease nipple through which grease is supplied.

9-1-2 TIE ROD

The tie rod, both ends having ball joints one for each, transmits the movement of the center arm to the right and left knuckles.

Each ball joint is grease sealed and its ball stud is fitted to the center arm and the knuckle. Two types of ball joints are used for the tie rods according to the thread direction of the rod connecting section. The right-hand threaded ball joint is fitted to the knuckle side and the left-hand threaded one to the center arm side.

9-1-3 CENTER ARM

The center arm, with two needle bearings press-fitted into the boss, is installed on the axle by a pin which is supported by the upper and lower bosses welded to the axle. The drag link and the power steering cylinder are connected to the center arm by ball joints.

9-1-4 DRAG LINK

The drag link is arranged between the steering gear pitman arm and center arm to feed back the movement of the center arm to the steering gear. From the power cylinder, the rod is fitted to the center arm with a ball joint while the cylinder tail to the frame.

■ Rear Wheel Bearing Pre-load Adjustment

(1) As shown in Fig. 9-2., apply grease on the hub, inner bearing, outer bearing and cap. Aslo apply grease on the lip of the oil seals.

(2) Set bearings on the hub and install the hub on the knuckle spindle.

(3) Install plain washer and tighten the castled nuts to the torque of 21-24 kg·cm (1.52-1.74 ft.lbs). Back off the castled nut then retighten to the torque of 1 kg·cm (0.072 ft.lbs).

(4) Lightly tapping the hub with a wooden hammer, rotate the hub 3 to 4 turns to make certain there is no looseness.

(5) Tighten the castled nut to the position which allows the cotter pin to be set.

(6) Tapping the hub with a wooden hammer, rotate the hub 3 to 4 turns to secure smooth rotation and measure the starting torque.
Starting torque: 0.3-0.8 kg·m (2.2-5.8 ft. lbs)

(7) When the starting torque is higher than the specified, replace the plain washer and castled nut.

(8) After the specified starting torque is obtained, lock the castle nut with cotter pin.

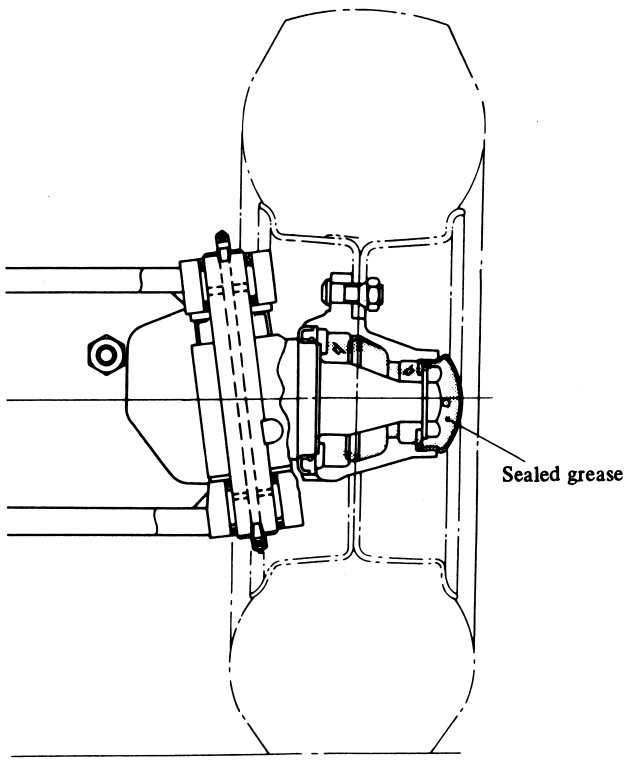


Fig. 9-2 Pre-load Adjustment

10. BRAKE SYSTEM

	2.0 – 2.5 ton	2.8 – 3.0 ton
Type:	Front two-wheel braking, internal expansion, hydraulic type	←
Pedal Ratio:	5.66	←
Master Cylinder:		
Type:	Conventional type	←
Cylinder Bore:	19.05 mm (0.75 in)	←
Wheel Brake:		
Type:	Duo-servo type with parking brake	←
Wheel Cylinder Bore:	28.58 mm (1.1 in)	←
Lining Size:	60 mm x 7 mm x 324 mm	76 mm x 8 mm x 348 mm
Width x thickness x length:	(2.4 in x 0.27 in x 12.6 in) 4 pcs.	(3.0 in x 0.3 in x 13.7 in)
Surface Area:	194.4 cm^2 x 4 (30 in^2 x 4)	264 cm^2 x 4 (41 in^2 x 4)
Inner Dia. of Brake Drum:	310 mm (12.2 in)	314 mm (12.4 in)
Parking Brake:	Front two-wheel braking, internal expansion, mechanical type	←

10-1 GENERAL DESCRIPTION

The brake system is the front two-wheel braking type consisting of a master cylinder, wheel brakes and brake pedal.

10-1-1 MASTER CYLINDER

The cylinder contains a valve seat, check valve, return spring, primary cup, separator, psiton, and secondary cup, which are all kept in place with stop washer and stop wire. The exterior of the cylinder is protected from dust by means of a rubber dust cover.

The piston is actuated through the push rod by operation of the brake pedal. First, as the brake pedal is pressed, the push rod pushes the piston forwards. The brake fluid in the cylinder flows back to the reserve tank through the return port until the primary cup blocks up the return port. After the primary cup passes the return port, the brake fluid in the cylinder is pressurized and opens the check valve, flowing through the brake lines to the wheel cylinders. Thus, each wheel cylinder piston is forced outwards. This brings the brake shoes into contact with the brake drum and slows or stops the truck. Meanwhile, the cavity caused behind the piston is filled with brake fluid led through the return port and inlet port to lubricate the piston.

When the brake pedal is released, the piston is forced back by the return spring. At the same time, the brake fluid in each wheel cylinder is pressurized by the force of the brake shoe return spring, thus returning into the master cylinder through the check valve. With the piston is in its original position, the fluid in the master cylinder flows into the reserve tank through the return port. The brake fluid in the brake lines and wheel cylinders has a residual pressure proportioned to the set pressure of the check valve, which makes each wheel cylinder piston cup securely seated to prevent oil leakage and eliminates a possibility of vapor lock when the truck is sharply braked.

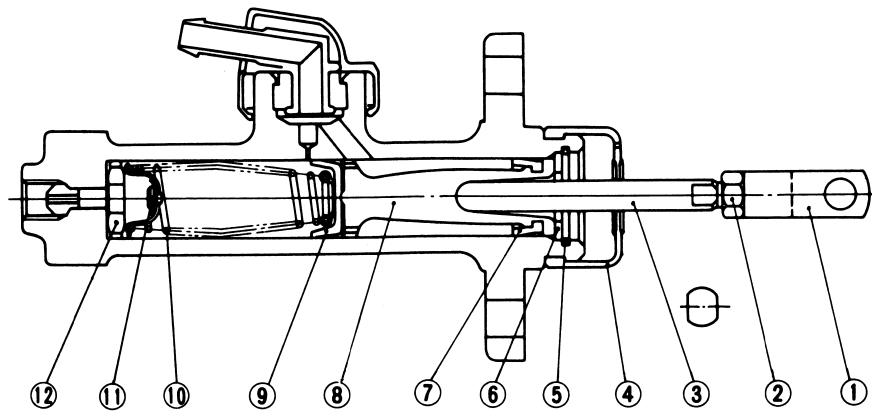


Fig. 10-1. Master cylinder

1. Yoke
2. Lock nut
3. Push rod
4. Dust cover
5. Stop wire
6. Stop washer
7. Secondary cup
8. Piston
9. Primary cup
10. Spring
11. Check valve
12. Valve seat

10-1-2 WHEEL BRAKE

The wheel brake is the internal expansion hydraulic type consisting of brake shoes, springs, a wheel cylinder, an adjuster and backing plates. Two wheel brakes are provided on each end of the front axle. The brake shoe, one end of it being connected to the anchor pin and the other end to the adjuster, is forced against the backing plate with a hold spring and pin. The primary shoe is provided with the parking brake lever and the secondary shoe with the actuator lever of the automatic clearance adjuster.

1. Spring
2. Piston cup
3. Piston
4. Boot
5. Push rod
6. Shoe return spring
7. Actuator rod
8. Actuator spring
9. Actuator lever
10. Primary shoe
11. Adjuster
12. Adjuster
13. Cable
14. Cap
15. Shoe hold-down pin
16. Brake lever
17. Strut
18. Wheel cylinder
19. Shoe return spring
20. Secondary shoe

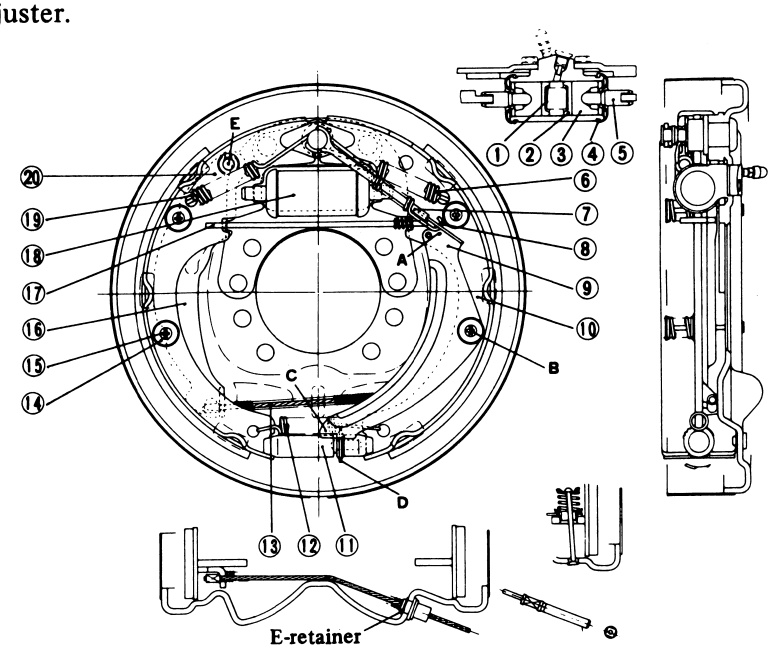


Fig. 10-2 Wheel Brake (Left-hand Side) (2.0 – 2.5 ton)

1. Wheel cylinder
2. Spring
3. Piston cup
4. Piston
5. Boot
6. Push rod
7. Return spring
8. Brake lining
9. Spring
10. Strut
11. Adjuster cable
12. Shoe
13. Cup
14. Hold-down pin
15. Spring
16. Spring
17. Adjuster lever
18. Return spring
19. Adjuster
20. Retainer
21. Backing plate
22. Return spring
23. Parking brake lever
24. Parking brake cable

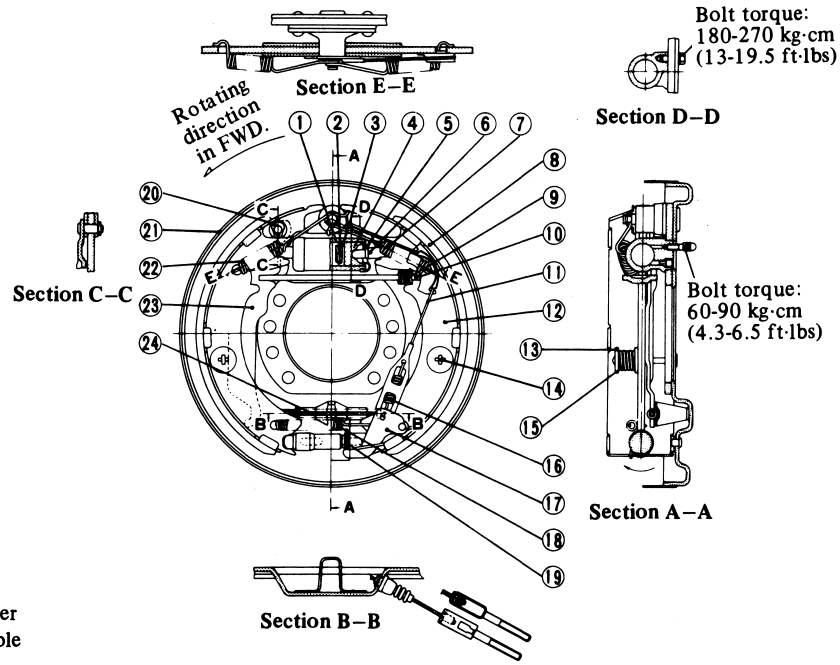


Fig. 10-3 Wheel Brake (2.8 – 3.0 ton)

The braking operation in forward travel is as follows: (See Fig. 10-4.) the primary and secondary shoes are forced by an equal force by operation of the wheel cylinder to bring the lining in contact with the brake drum. The primary shoe forces the adjuster with the aid of lining-to-drum friction force. Due to this, the adjuster pushes the adjuster end of the secondary shoe by a larger force than that offered by the wheel cylinder operation. The secondary shoe anchor end is forced strongly against the anchor pin, providing large braking force. On the other hand, the braking operation in reverse travel is performed in the reverse direction, but the braking force is the same as in the case of the forward travel.

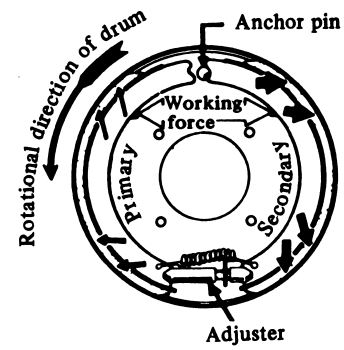


Fig. 10-4 Braking Operation in Fwd Travel

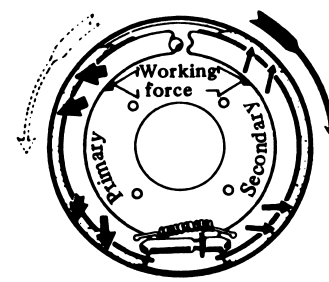


Fig. 10-5 Braking Operation in Rev. Travel

10-1-3 AUTOMATIC CLEARANCE ADJUSTER

The automatic clearance adjuster keeps a lining-to-brake drum clearance of 0.4 to 0.45 mm (0.016 – 0.017 in) automatically. This adjuster, however, actuates only when the truck is braked in reverse travel. When the brake pedal is pressed in reverse travel, the brake shoes are expanded. As a result of this, the secondary and primary shoes come into contact with the brake drum and rotate together until the upper end of the primary shoe comes into contact with the anchor pin.

On the other hand, as the secondary shoe leaves the anchor pin, the section (A) of the actuator lever is relatively pulled. Therefore, the actuator lever turns around the section (B) so that the section (C) of the actuator lever lowers, causing the section (D) of the adjuster to turn to the left. As the brake pedal is further pressed, compression force applied on the adjuster becomes larger. This results in increased resistance on the thread so that the actuator lever force can not turn the section (D).

10-1-4 PARKING BRAKE

The parking brake is the mechanical, internal expansion type and built in the wheel brake. The brake shoes and brake drum are commonly used with the wheel brake system. As the parking brake lever is pulled, the parking brake lever pushes the strut to the right with the pin (E) as a fulcrum, forcing the secondary shoe against the brake drum.

[105325]

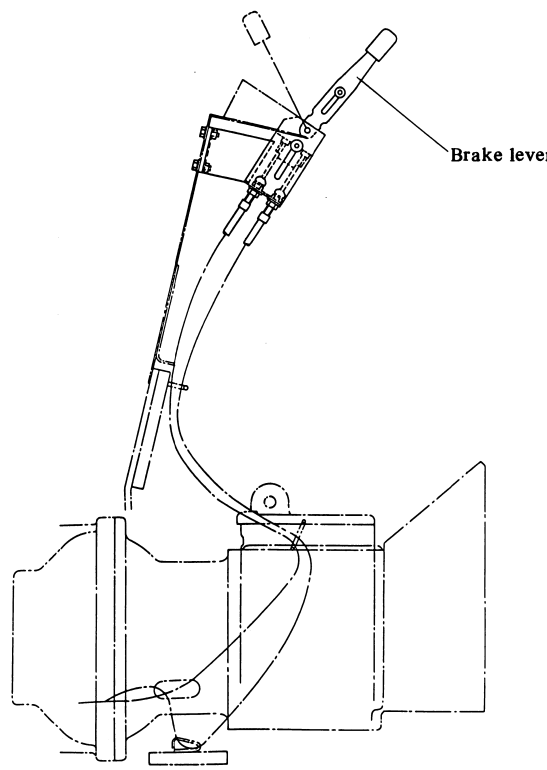


Fig. 10-6 Parking Brake

10-1-5 BRAKE PEDAL ADJUSTMENT (CLUTCH TYPE TRUCK)

(1) Make the push rod short.

(2) Adjust the pedal height for 120 mm (4.8 in) for the gasoline model and 113 mm (4.6 in) for the diesel model with the stopper bolt.

(3) With the brake pedal pressed 40 mm (4.6 in), pull the push rod out until its front end comes into contact with the master cylinder piston.

(4) Tighten the push rod lock nut.

[104831]

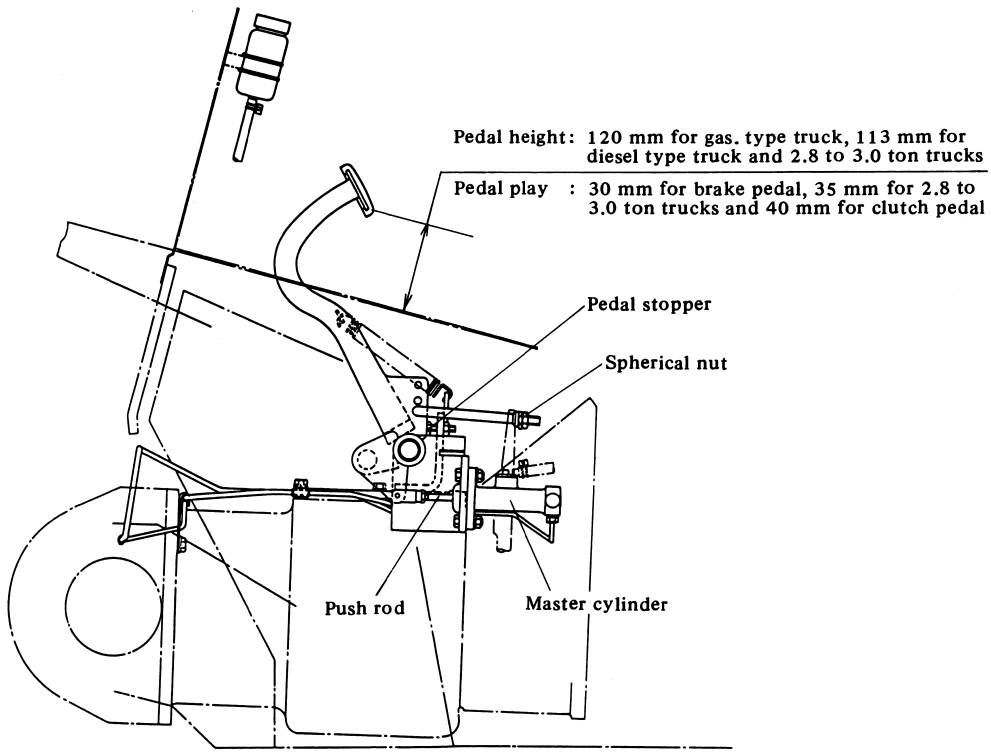

Pedal height: 120 mm for gas. type truck, 113 mm for diesel type truck and 2.8 to 3.0 ton trucks
Pedal play : 30 mm for brake pedal, 35 mm for 2.8 to 3.0 ton trucks and 40 mm for clutch pedal
Pedal stopper
Spherical nut
Push rod
Master cylinder

Fig. 10-7 Brake Pedal Adjustment (Clutch Type Truck)

10-1-6 BRAKE PEDAL ADJUSTMENT (TORQUE CONVERTER TYPE TRUCK)

(1) Loosen the push rod and interlocking bolt.

(2) Adjust the pedal height for 120 mm (4.8 in) for the gasoline model and 113 mm (4.6 in) for the diesel model with the stopper bolt.

(3) Adjust the left-side pedal (inching pedal) for 1-2 mm (0.039-0.079 in) travel with the turn buckle.

(4) Press the right-hand side pedal 60 mm (2.36 in) and adjust the push rod lenght so that the front end of the push rod is in contact with the master cylinder piston, then lock with lock nut.

(5) Pull down the interlocking bolt until its head comes in contact with the bar, and lock it.

[104832]

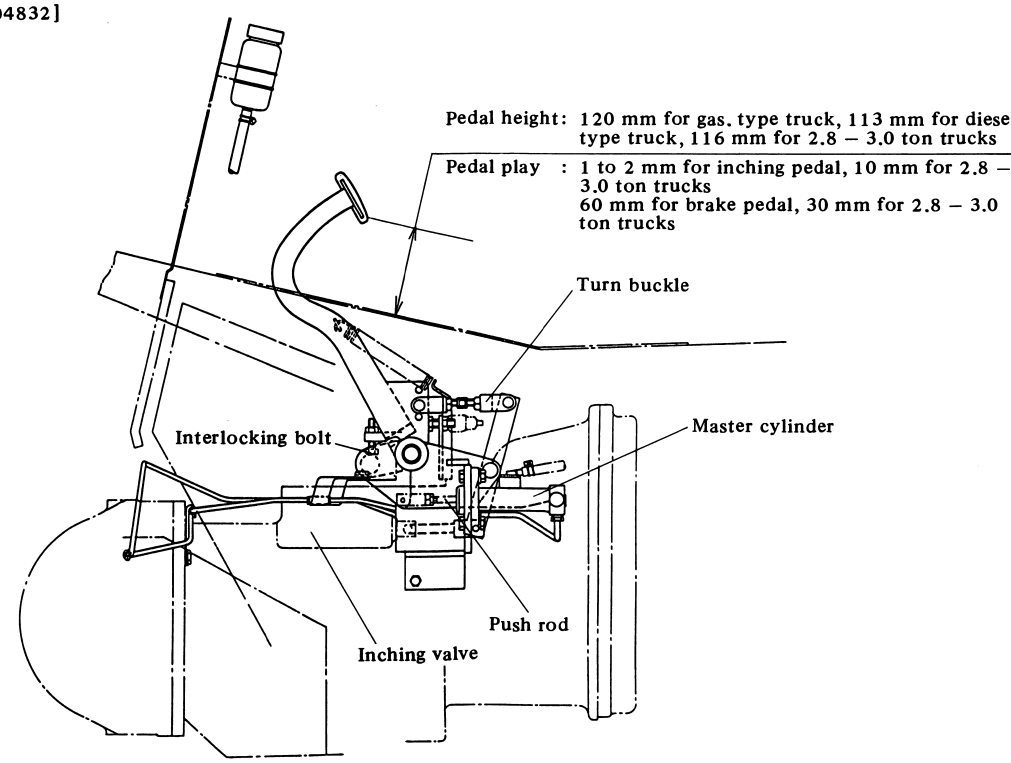

Pedal height: 120 mm for gas. type truck, 113 mm for diesel type truck, 116 mm for 2.8 – 3.0 ton trucks
Pedal play : 1 to 2 mm for inching pedal, 10 mm for 2.8 – 3.0 ton trucks
60 mm for brake pedal, 30 mm for 2.8 – 3.0 ton trucks
Turn buckle
Interlocking bolt
Master cylinder
Push rod
Inching valve

Fig. 10-8 Brake Pedal (Tor-Con Type Truck)

10-2 MAINTENANCE

This paragraph covers the disassembly, reassembly and adjustment of the wheel brake. With 2.8 to 3.0 ton trucks, the structure of brake differs partially. The maintenance procedure, however, is the same.

10-2-1 WHEEL BRAKE DISASSEMBLY

(1) Remove the hold-down spring of secondary shoe. Remove the pole lever, pole lever stopper and actuator spring.

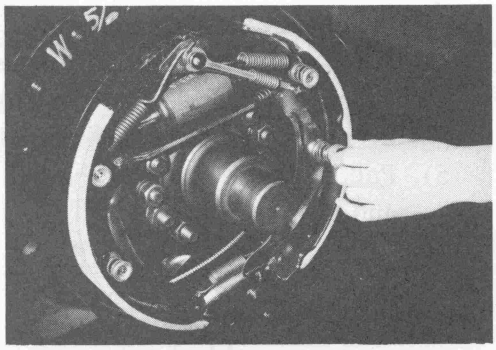


Fig. 10-9

(2) Remove two shoe return springs.

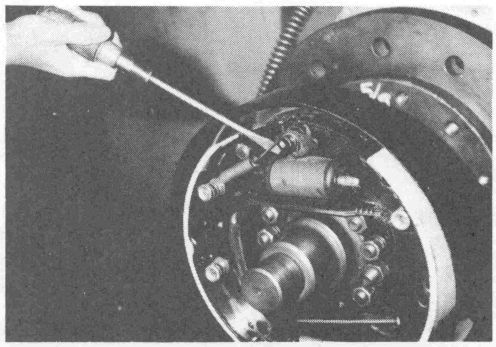


Fig. 10-10

(3) Remove three hold-down springs.

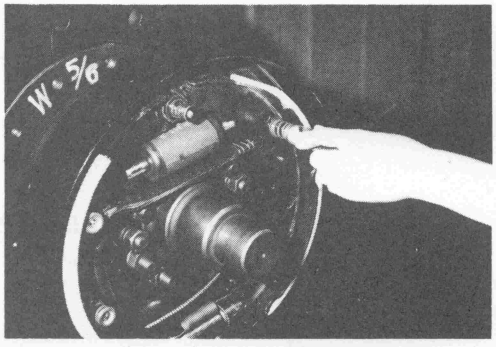


Fig. 10-11

(4) Remove the primary and secondary shoes. At the same time, remove the adjuster and adjuster spring.

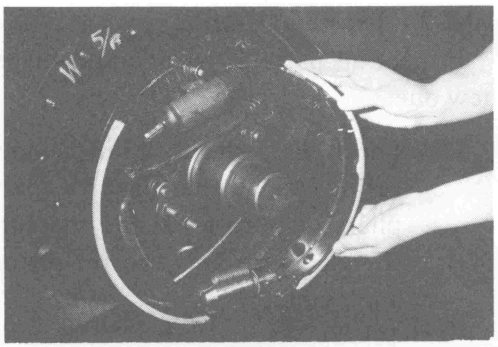


Fig. 10-12

(5) Remove the brake line from the wheel cylinder. Remove wheel cylinder mounting bolts and detach the wheel cylinder from the backing plate.

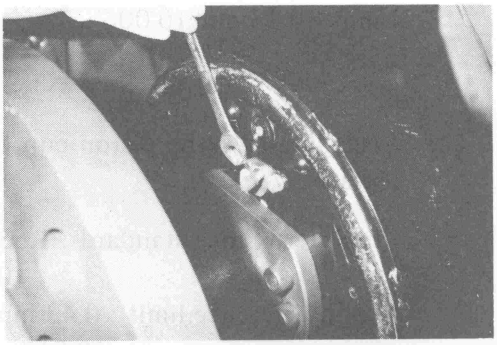


Fig. 10-13

(6) Remove the E-retainer securing the parking brake cable to the backing plate. Remove the backing plate mounting bolts and detach the backing plate from the axle.

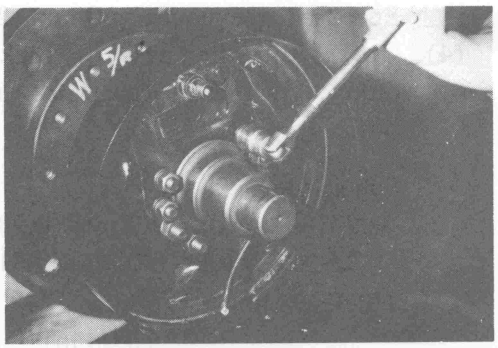


Fig. 10-14

(7) Remove the boot and push the piston into the cylinder

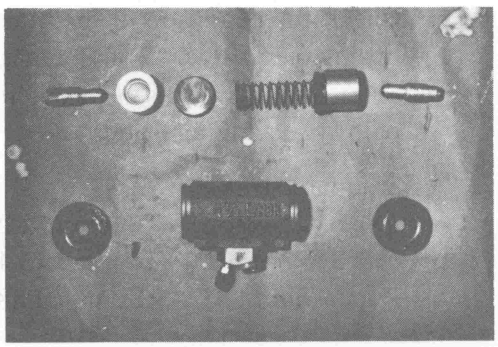


Fig. 10-15

10-2-2 INSPECTION

Inspect all parts for wear and damage. If unsatisfactory, repair or replace with new one.

(1) Check the wheel cylinder inner surface and the piston's periphery for rust. Then, measure the clearance between the piston and cylinder.

Specified value : 0.03-0.10 mm (0.0012-0.0039 in)
Limit : 0.15 mm (0.006 in)

Fig. 10-16

(2) Visually check the piston cup for damage or deformation. If unsatisfactory, replace.

Cup interference standard : 1.53 mm (cup o.d. of 30.1 mm) [0.06 in (cup o.d. of 1.19 in)]
Cup interference limit : 0.43 mm (cup o.d. of more than 29.0 mm) [0.017 in (cup o.d. of more than 1.14 in)]

(3) Check the free length of the wheel cylinder spring. If unsatisfactory, replace.
Specified free length : 60 mm (2.36 in)

(4) Check the thickness of brake lining. If excessive wear is noticed, replace.

Specified thickness:
2.6 – 2.5 ton: 7.0 mm (0.28 in)
2.8 – 3.0 ton: 8.0 mm (0.31 in)
Thickness limit : 2.0 mm (0.08 in)

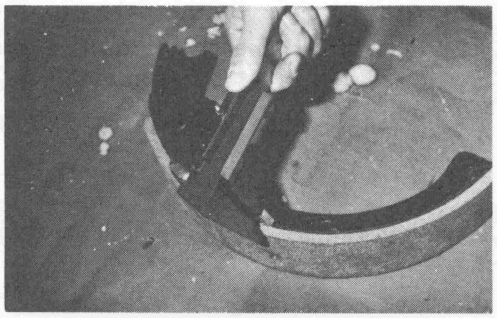


Fig. 10-17

(5) Check the condition of the brake drum inner surface. If any damage or excessive wear is noticed, repair by machining or replace.

Standard size:
2.0 – 2.5 ton: 310 mm (12.2 in)
2.8 – 3.0 ton: 314 mm (12.4 in)
Repair limit: STD + 2 mm (0.08 in)

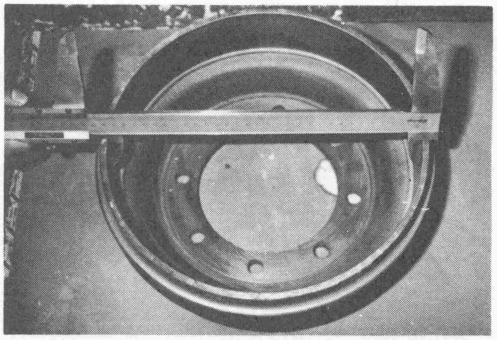


Fig. 10-18

(6) Measure the free length and setting load of the shoe return spring.

Free length : 106 mm (4.2 in)
Setting length : 116 mm
(4.6 in)
Setting load : 25.1 kg
(55.4 lbs)

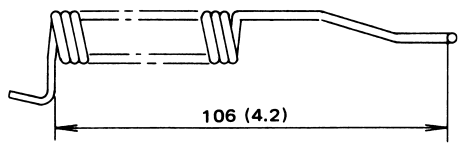


Fig. 10-19

(7) Measure the free length and setting load of the actuator spring.

Free length : 124.5 mm(4.9 in)
Setting length : 130 mm (5.1 in)
Setting load : 25 kg (55.1 lbs)

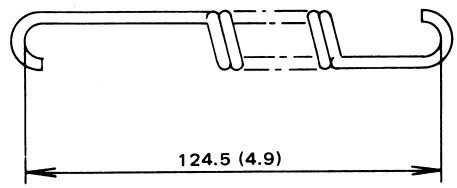


Fig. 10-20

(8) Measure the free length and setting load of the adjuster spring.

Free length : 92 mm (3.6 in)
Setting length : 97 mm (3.8 in)
Setting load : 7.1 kg
(15.7 lbs)

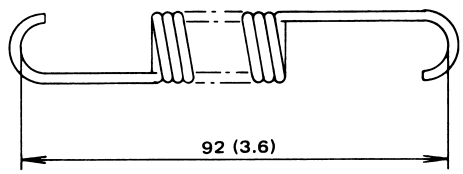


Fig. 10-21

(9) Check the adjuster gear for damage and operating condition, and also check to see that the adjuster gear contact points of the pole lever gear are free of any defect. Replace if necessary.

10-2-3 WHEEL BRAKE REASSEMBLY

(1) Apply brake fluid to the wheel cylinder cup and piston, and reinstall spring, cup, piston and dust cover in this order.

(2) Install the wheel cylinder on the backing plate.
CAUTION : Make sure you have the correct side of each component when installing it. Bolts should be torqued to 1.5 to 2.0 kg.m (10.8 to 14.5 ft.lbs).

(3) Install the backing plate on the front axle.
Torque the mounting bolts to 12 to 14 kg.m (86.8 to 101 ft.lbs).

(4) Apply heat-resistant grease (Nippon Oil Therma-knock No.2) on the points indicated in Fig. 10-22, with due care not to contaminate the lining with grease.

(a) : Backing plate shoe ledge surface
(b) : Anchor pin
(c) : Sleeve surface on which shoes and pole lever are to contact
(d) : Parking brake lever pin
(e) : Adjuster thread and other rotating parts

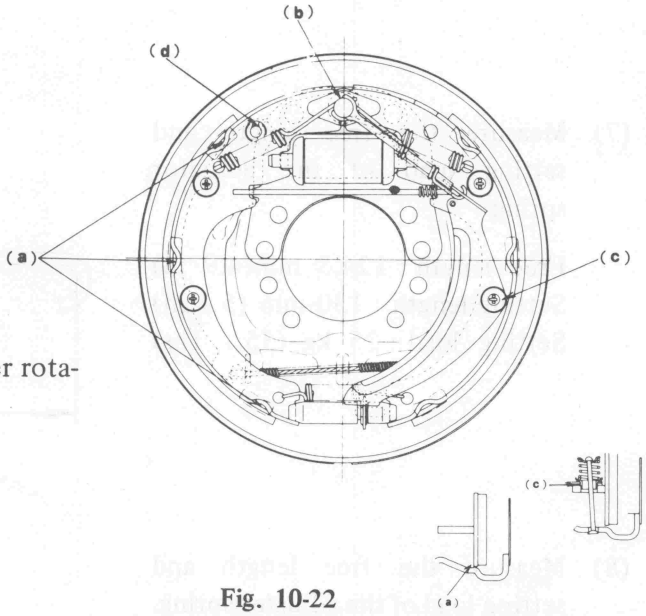


Fig. 10-22

(5) Install the parking brake cable on the backing plate with an E-retainer.

(6) Install shoes with hold-down springs. However, the secondary shoe lower part should be given a hold-down spring only after the pole lever and sleeve are mounted. Make sure the sleeve settles snugly in the shoe and pole lever hole.

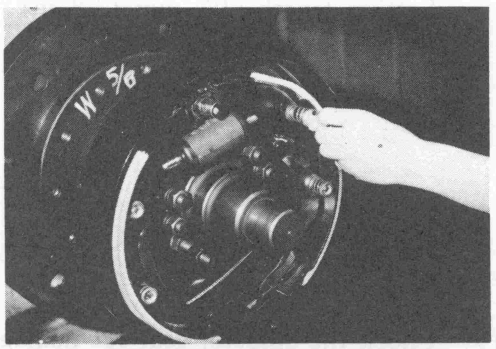


Fig. 10-23

(7) Put the anti-rattle spring in the strut then install it on the shoe.

(8) Install the shoe guide plate on the anchor pin, and install the shoe return spring.

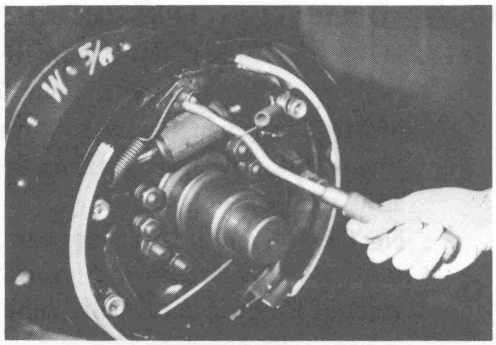


Fig. 10-24

(9) Install the adjuster, adjuster spring, pole lever stopper and actuator spring, paying attention to the following points:

① Adjuster thread direction and its mounting direction (i.e. right-hand thread for left-side brake and left-hand thread for righ-side brake.)

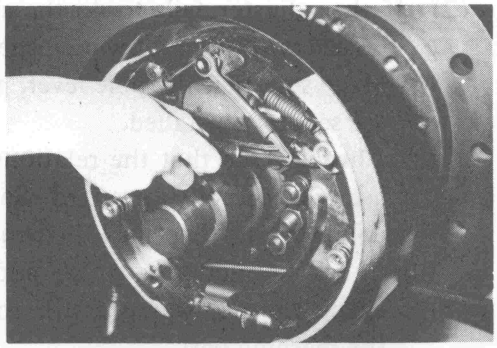


Fig. 10-25

② Adjuster spring direction. (Do not allow the adjuster gear teeth contact with the spring.)

③ Actuator spring direction (Spring hook at anchor pin side should be located at the opposite side to pole lever stopper.)

④ Pole lever stopper and actuator spring should be located in the groove on the anchor pin.

⑤ Make sure that the pole lever end is in contact with the adjuster gear teeth.

(10) Install the brake line on the wheel cylinder.

(11) Measure the inner dia. of drum. Adjust the adjuster to obtain brake shoe outer diameter to drum inner diameter – 0.8 or 0.9 mm (0.030 or 0.035 in).

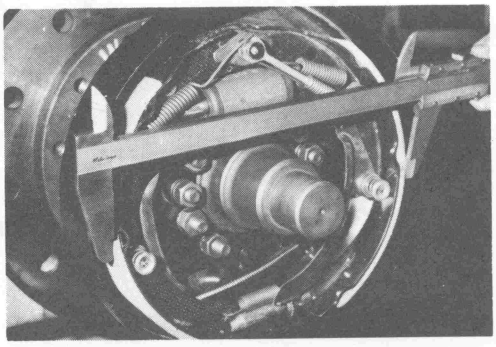


Fig. 10-26

10-2-4 OPERATION TEST OF AUTOMATIC CLEARANCE ADJUSTER

(1) Make the brake shoe diameter nearly the specified mounting size, and pull the pole lever with your finger along the arrow mark as shown in the illustration given below to turn the adjuster gear. When removing off your finger, the pole lever returns to its original position without rotation of the adjuster gear.

NOTE : Even if the adjuster gear turns back along with the pole lever motion when removing your finger, the adjuster will operate normally, when it is put in on-the-machine conditions.

(2) If the adjuster fails to do the above operation when pulling the pole lever, proceed with the following inspection.

(a) Make sure that the pole lever, pole lever stopper, actuator spring, and sleeve are securely installed.

(b) Check to see that the relationship between the pole lever and the adjuster gear is correctly arranged. See Fig. 10-27. If unsatisfactory, replace the component. Also check that the pole lever is in contact with the gear.

(c) Check the actuator spring and adjuster spring for deterioration, and also check the adjuster gear for rotating condition, undue wear or damage of the meshing part.

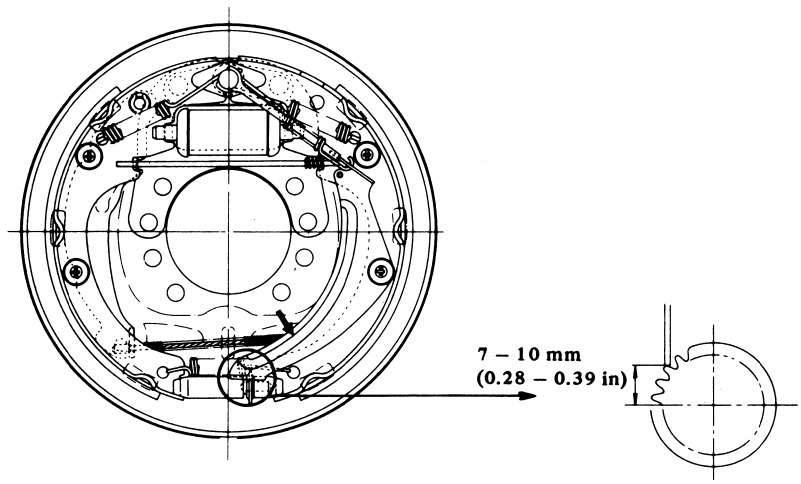


Fig. 10-27

10-2-5 WHEEL BRAKE TROUBLESHOOTING

Problem	Probable Cause	Remedy
Poor braking	1. Fluid leaks from brake system	Repair.
	2. Maladjustment of brake shoe clearance	Adjust the adjuster
	3. Overheating brake	Check for dragging.
	4. Poor contact between brake drum and lining.	Readjust.
	5. Foreign matter adhered on lining	Repair or replace.
	6. Foreign matter mixed in brake fluid	Check brake fluid.
	7. Maladjustment of brake pedal (inching valve)	Adjust
Noisy brake	1. Hardened lining surface or foreign matter adhered thereto.	Repair or replace.
	2. Deformed backing plate or loose bolts	Repair or replace.
	3. Deformed shoe or incorrect installation	Repair or replace.
	4. Worn lining	Replace.
	5. Loose wheel bearing	Repair
Uneven braking	1. Contaminated lining.	Repair or replace.
	2. Maladjustment of brake shoe clearance	Adjust the adjuster
	3. Malfunctioning wheel cylinder	Repair or replace.
	4. Shoe return spring deteriorated	Replace
	5. Deflected drum	Repair or replace.
Soft or spongy brake	1. Brake fluid leaks from system	Repair
	2. Maladjustment of brake shoe clearance	Adjust the adjuster
	3. Air mixed in system	Bleed air.
	4. Maladjustment of pedal	Readjust.

11. HYDRAULIC SYSTEM

	FG20N2S FG23N2S FG25N2S	FG28N7S FG30N7S	FD20Z2S FD23Z2S FD25Z2S	FD28Z7S FD30Z7S
Main Pump				
Model:	KRP4–23CSSB	KRP4–30CSSB	KRP4–30ASSS	←
Type:	Gear type			
Drive:	Engine PTO			
Discharge:	22.9 cc/rev	30.0 cc/rev	←	←
Control Valve				
Model:	KVS–65N–2VPF			
Type:	Two spool sliding type, with relief valve and tilt lock valve			
Set pressure:	175 kg/cm^2 (2489 psi)			
Lift Cylinder				
Type:	Single acting piston, with cut off valve and flow regulator valve			
Cylinder bore:	50 mm (1.97)	55 mm (2.16)	50 mm (1.97)	55 mm (2.16)
Stroke:	1495 mm (58.86) [This varies depending on type of mast.]			
Tilt Cylinder				
Type:	Double acting piston			
Cylinder bore:	71 mm (2.80 in)			
Piston rod o.d.:	32 mm (1.26 in)			
Stroke:	151 mm (5.95 in) [This varies depending on type of mast.]			

11-1. GENERAL DESCRIPTION

The hydraulic system consists of a main pump, control valve, lift cylinders, and tilt cylinders. The main pump is driven directly by the PTO device of the engine.

11-1-1. MAIN PUMP

The main pump is a gear type consisting of a pump body of aluminum alloy, one pair of gears that are precisely machined, and bushings and packings. This pump uses pressure-balance type bearings and a special lubrication method so as to get the minimum clearance of the gear flank.

Since the pump body and cover are made of aluminum alloy, they are light and rigid. The drive gear and driven gear are integrated with their respective shafts, which are held against the pump body with bushings. The bushings, made of gun metal, serves both as bearings for each shaft and as side plates for the gear flank.

At the drive shaft side, an oil seal is press-fitted into the pump body to provide oil tightness performance. Oil tightness between the pump body and the pump cover is secured with a packing of a special shape.

11-1-2. CONTROL VALVE

The control valve consists of an inlet section, two plunger sections and an outlet section, all of which are assembled with three bolts. The two plunger sections are used for lift and tilt circuits, respectively.

The plunger section for the lift circuit is a single-acting type: when the spool is drawn out, oil flows from the port A to the lift cylinders and when the spool is pushed in, the oil flows out of the lift cylinders and passes through the port B and control valve back to the oil tank.

The tilt circuit plunger section is of double-acting type. With the spool drawn out, the oil flows from the port A to the cap side of the tilt cylinders, while the oil in the tail side of the cylinders returns through the port B and control valve to the tank. When the spool is pushed in, the flow becomes reversed.

The plunger section for the tilt circuit has a built-in tilt-lock valve.

The inlet section has a relief valve which regulates the oil pressure for the main circuit and steering circuit and a flow divider which divides the flow of oil from the main pump into two lines: load handling and steering. At the steering circuti port of the flow divider is a check valve.

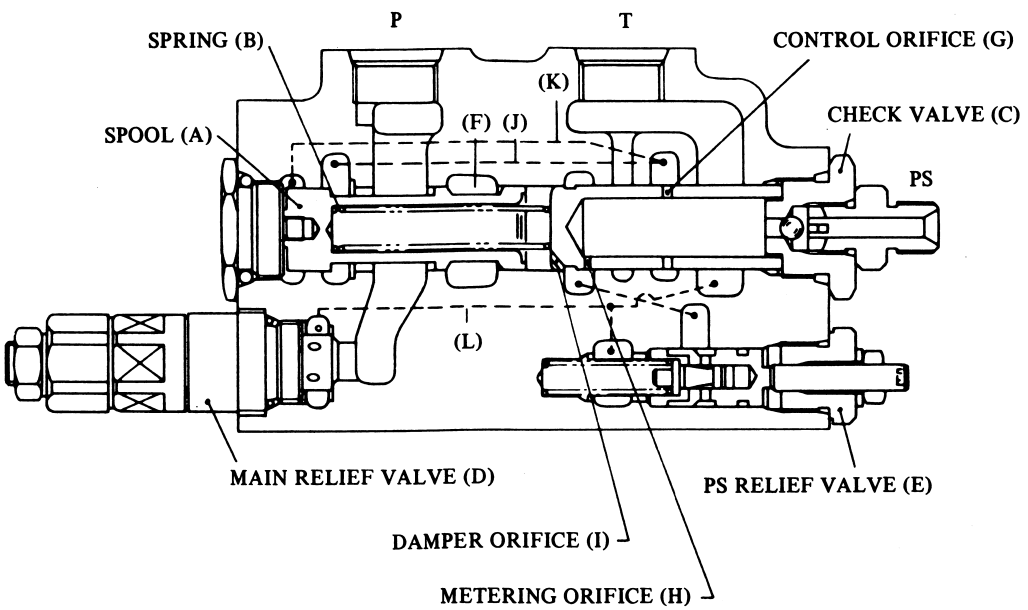


Fig. 11-1 Inlet Section

(1) Operation of Plunger

(a) Neutral

Oil discharged from the main pump flows through the neutral passage back to the oil tank.

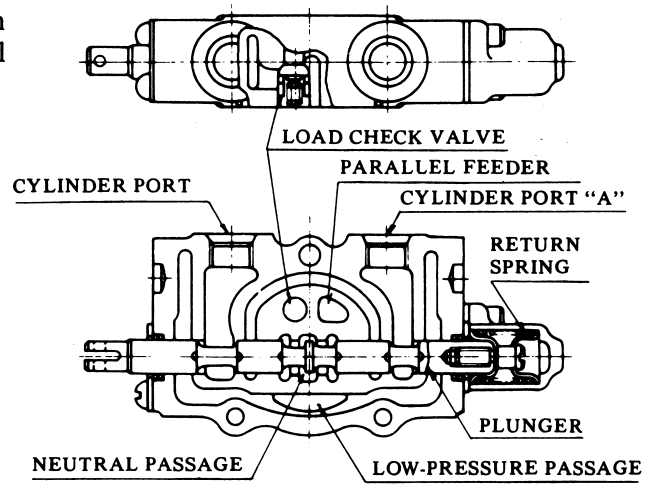


Fig. 11-2

(b) Pushing in of Plunger

The neutral passages are closed and the oil flows through parallel feeder, pushing up the load check valve, into the cylinder port "B". The returning oil from the cylinder port "A" flows through the low-pressure passage to the tank. The plunger is restored to the neutral position by the return spring.

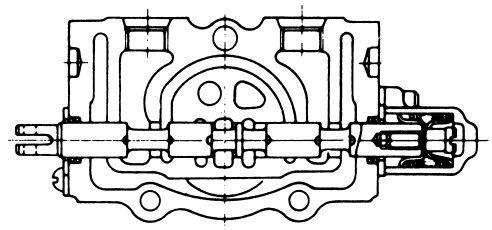


Fig. 11-3

(c) Drawing out of Plunger

With the neutral passage closed, the oil pushes up the load check valve, passing through the parallel feeder, and flows into the cylinder port "A". The returning oil from the cylinder port "B" flows through the low-pressure passage to the tank. The plunger is restored to the neutral position by the return spring.

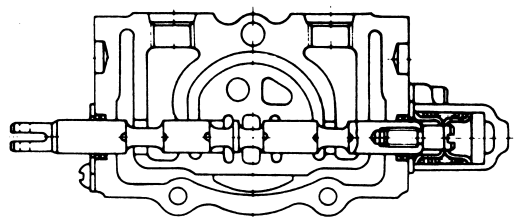


Fig. 11-4

(2) Operation of Tilt Lock Valve

The control valve has a tilt lock valve which prevents vibrations of the mast due to possible creation of internal negative pressure in the tilt cylinder and also avoids danger incurred from mishandling of the tilt lever.

When the plunger is drawn out, the oil flows in the same manner as in Fig. 11-4.

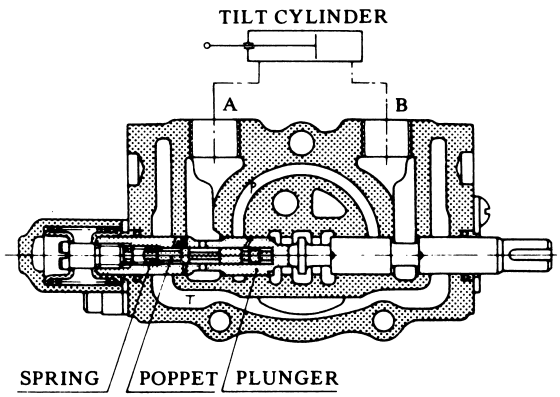


Fig. 11-5

(a) Pushing in of Plunger

The oil from the main pump flow through the port "B" to the tilt cylinders. The returning oil from the cylinders flows through the oil hole "A" to actuate the poppet. This allows the oil to pass through the plunger holes "A" and "B" to the low-pressure passage and back to the tank.

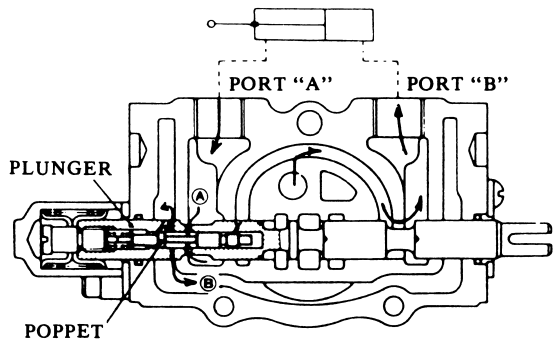


Fig. 11-6

(b) Pushing in of Plunger

When the plunger is pushed in with the engine shut off, the oil does not flow to the cylinder port "B" and the pressure at area "P" does not rise as well because the main pump is inoperative.

Also, the poppet does not move so that the oil at the cylinder port "A" does not return to the tank. The cylinders thus remains unmoved.

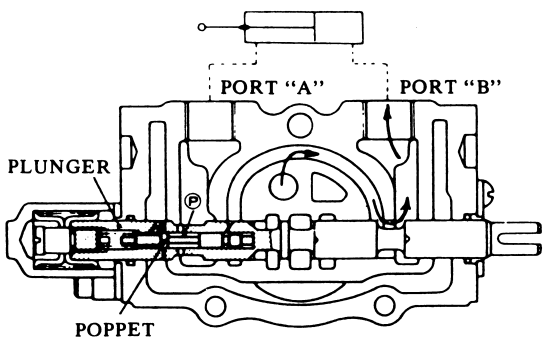


Fig. 11-7

(3) Operation of Inlet Cover

(a) Discharge smaller than set flow rate

The oil from the pump flows through the oil passage "J" and orifice "G" to the PF side. The oil pressure in front of the orifice "G" is applied through the passage k to the front of the spool "A" while the oil pressure behind the orifice "G" is applied through the orifices "H" and "I" to the back of spool "A". The pressure differential across the orifice "G" thus acts on the spool "A" in the direction that compresses the spring "B". However, the part "M" of the spool "A" does not open toward the EF side due to spring force, allowing all the oil to flow to the PF side.

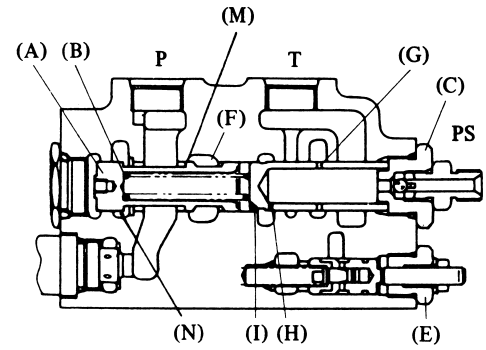


Fig. 11-8

(b) Discharge larger than set flow rate

When the oil flow from the pump exceeds the set flow rate, the pressure differential across the orifice "G" increases to move the spool A so that the part "M" opens to allow excess oil to flow to the EF side. If the PF side circuit actuates and the pressure rises, the spool "A" automatically shifts so that the opening of the part "M" becomes smaller, thus attaining specified working pressure and flow rate.

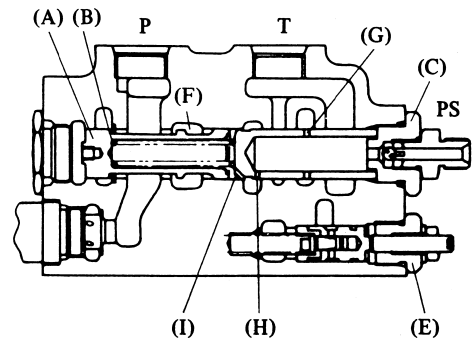


Fig. 11-9

(c) Actuation of EF side circuit

When the oil flows to the EF side, the EF side circuit actuates. As the pressure increases, the pressure differential across the orifice "G" becomes larger, shifting the spool "A" and narrowing the opening of the part "M" to prevent the amount of oil more than the set flow rate to flow to the PF side.

(d) Simultaneous actuation of both PF and EF side circuits

As both pressures in the PF and EF sides increase simultaneously, the opening of the part "M" is automatically determined so that the flow rate is ket constant.

(e) PF side circuit pressure reaching relief pressure

When the pressure in the PF side circuit increases to the extent that the relief valve "E" actuates the oil flows to the tank at the flow rate determined by the orifice "H". At this time, the flow of oil to the EF side increases accordingly.

(4) Operation of Main Relief Valve

(a) The oil in the high-pressure passage "HP" flows through the oil hole in the piston "C" to affect the two areas "A" and "B" which are different in diameter, so that the poppets "D" and "K" are securely seated.

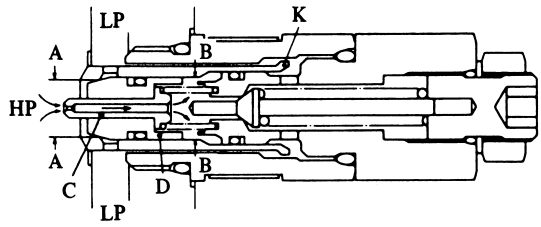


Fig. 11-10

(b) When the pressure in the high-pressure passage "HP" reaches the setting pressure of the pilot spring, the pilot poppet "E" opens. The oil passes around the poppet, flows through the drilled hole to the low-pressure side "LP".

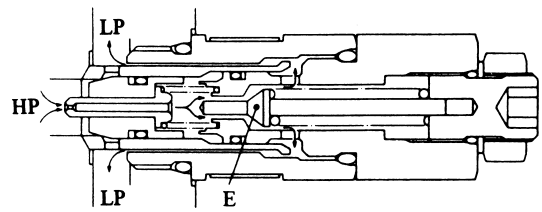


Fig. 11-11

(c) As the pilot poppet "E" is opened, the pressure behind the poppet "D" drops. As compared to the pressure at the high-pressure side HP, the inner pressure becomes unbalanced, causing the poppet "D" to open and thereby sending the oil directly to the low-pressure passage "LP".

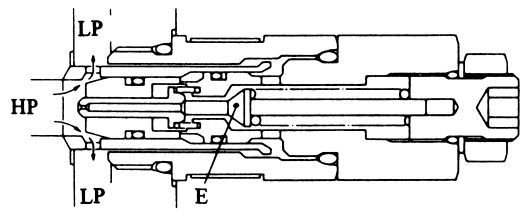


Fig. 11-12

(d) When the pressure in the high-pressure passage "HP" is lower than that in the low-pressure passage, the poppet "D" opens due the difference between the areas "A" and "B", allowings enough oil from the low-pressure passage "LP" to the high-pressure passage "HP".

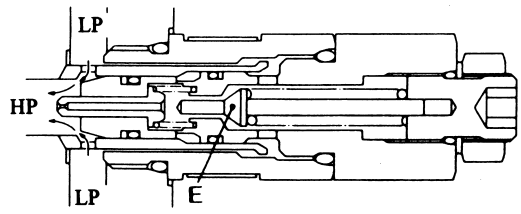


Fig. 11-13

(5) Operation of Port Relief Valve (Option)

(a) The oil flows through the hole in the main poppet "C" to fill the chamber "D" so that the main poppet "C" and the sleeve "E" are securely seated due to the difference in area.

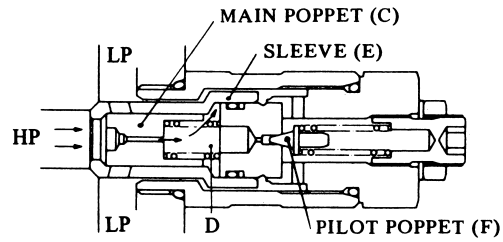


Fig. 11-14

(b) When the pressure in the high-pressure passage "HP" reaches the set pressure of the pilot spring, the pilot poppet "F" opens, allowing the oil to flow around the pilot poppet, past the drilled hole, to the low-pressure passage "LP".

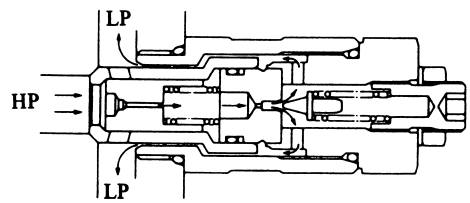


Fig. 11-15

(c) As the pilot poppet "F" opens, the pressure in the chamber "D" drops and thereby main poppet "C" opens to let the oil in the high-pressure passage "HP" flow directly to the low-pressure passage "LP".

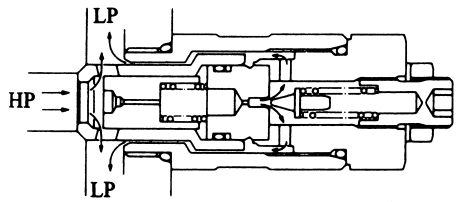


Fig. 11-16

11-1-3. OIL CIRCULATION ROUTE

The hydraulic piping is of "O"-ring fitting type with excellent sealing performance, providing secure oil tighteness. The hydraulic oil from main pump, with the control valve in neutral, passes through the valve and returns back to the oil tank. When the lift lever is pulled, the oil from the control valve flows through the flow regulator and reaches the lower part of the lift cylinder piston, pushing up the piston rod. When the lift lever is pushed forward, the circuit between the lower part of the lift cylinder piston and the oil tank is opened, and the piston begins to descend due to the weight of the piston rod, carriage, fork, etc. In this case, the oil returning to the control valve is regulated by the flow regulator. When the tilt lever is operated, the hydraulic oil from the main pump reaches one side of the piston to push it. The oil pushed by the piston returns to the oil tank through the control valve.

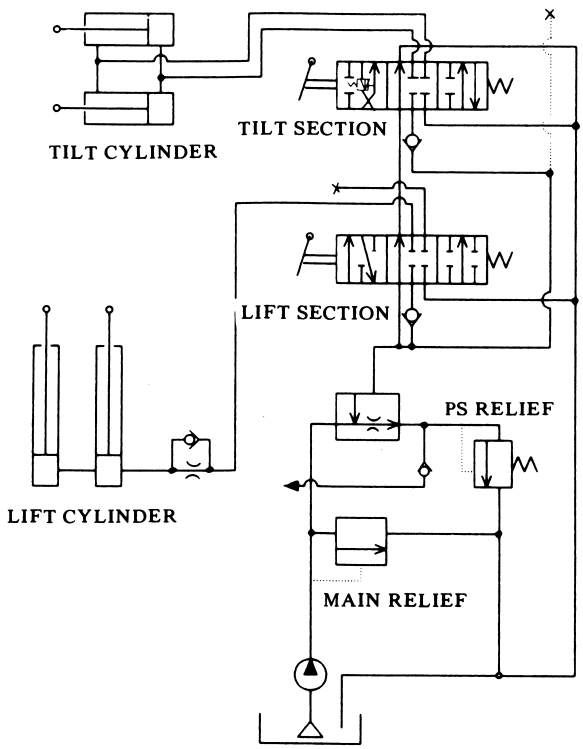


Fig. 11-17

[105270]

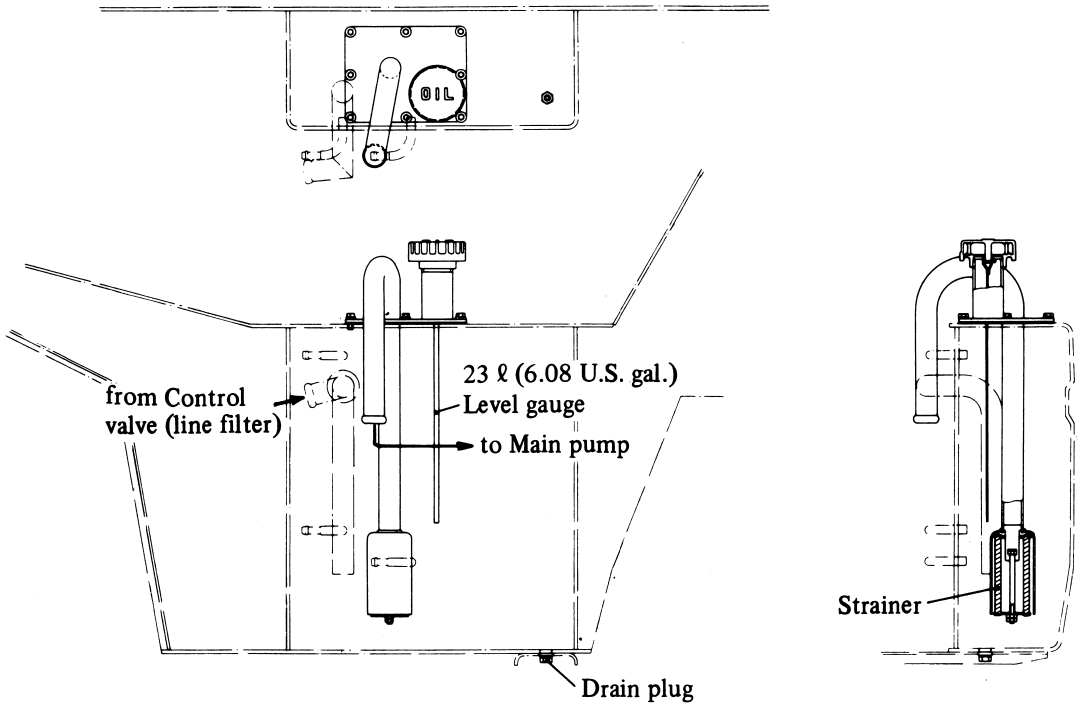


Fig. 11-18. Oil Tank

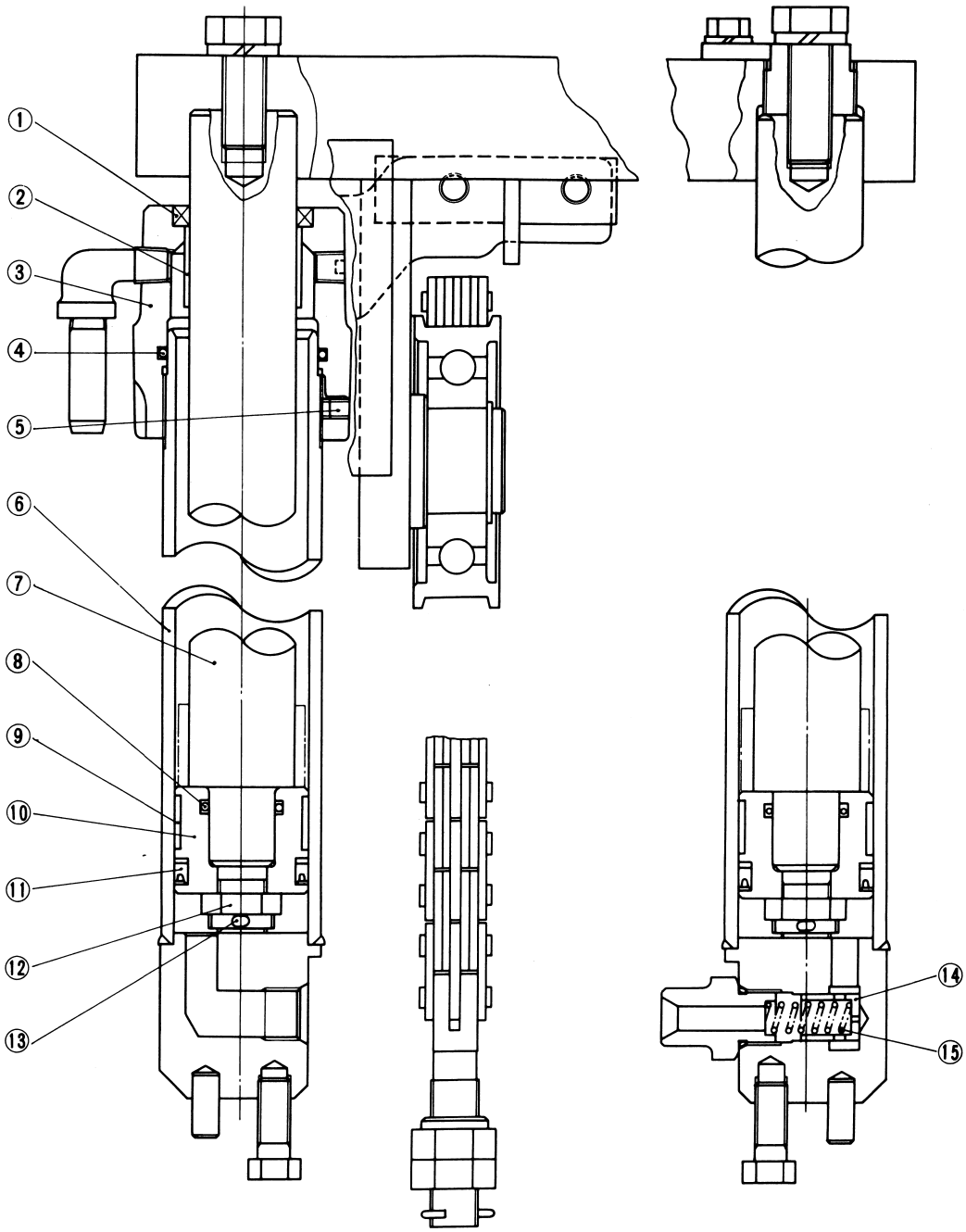
11-1-4. LIFT CYLINDER

The two lift cylinders of single-acting type are located behind the outer mast frame and their bottoms are supported by the mast support of outer mast frame while their tops, or the piston heads, are held by the inner mast piston head guide.

The lift cylinder assembly consists primarily of cylinder body, piston, piston rod, cylinder cap, and piston head. At the lower part of the cylinder body is provided a high-pressure oil inlet while at the upper part is provided a low-pressure oil outlet to which a return pipe is connected.

The piston, fastened to the piston rod with castle nut and cotter pin together with an O-ring, is given a wear ring, packing and back-up ring on its circumference and slides along the inside of cylinder by high-pressure oil. The cylinder cap fitted with bushing and oil seal is screwed into the cylinder body. This bushing serves to support the piston rod, and the oil seal prevents dirt from entering the cylinder. The piston head, fitted to the top of piston rod with castle nut, has sheaves at the both sides which are installed with snap rings.

When the lift lever is pulled toward the operator, high-pressure oil flows into the lower part of each lift cylinder so that the piston rod as well as piston is raised. This lifts the piston head up, lifting the fork through the lift chain. On the other hand, when the lift lever is pushed forward, the piston descends by the weights of the piston rod, piston head, lift bracket, finger bar and fork, causing the oil under the piston to flow out of the cylinder. The oil discharged from the cylinders is regulated by the flow regulator and returns through the control valve to the oil tank.



1. Dust seal
2. Bushing
3. Cylinder cap
4. "O"-ring
5. Lock screw
6. Cylinder
7. Piston rod
8. "O"-ring
9. Wear ring
10. Piston
11. Packing
12. Lock nut
13. Cotter pin
14. Cut valve
15. Spring

Fig. 11-19. Lift Cylinder

11-1-5 FLOW REGULATOR VALVE

The flow regulator valve is provided in the lift cylinder circuit in order to stabilize the descending speed of forks. Fig. 11-13 shows its structure.

The oil from the control valve flows into the lift cylinder through the chambers (A) and (B), the holes (C), (D), (E), (F), and then the chamber (G). In this state the oil flows to the lift cylinder without may control.

When the control valve is set to the descending position, the oil flows from the lift cylinder into the control valve through (G), (F), (E), (D), (C), (B) and (A). When the oil presses through the orifice 5 , pressure difference occurs between the chambers (A) and (B). If the pressure difference exceeds the force of spring 2 , the piston 7 moves to the right. Therefore, the oil is throttled by the holes (D) and (C), thereby decreasing the amount of oil passing through the orifice.

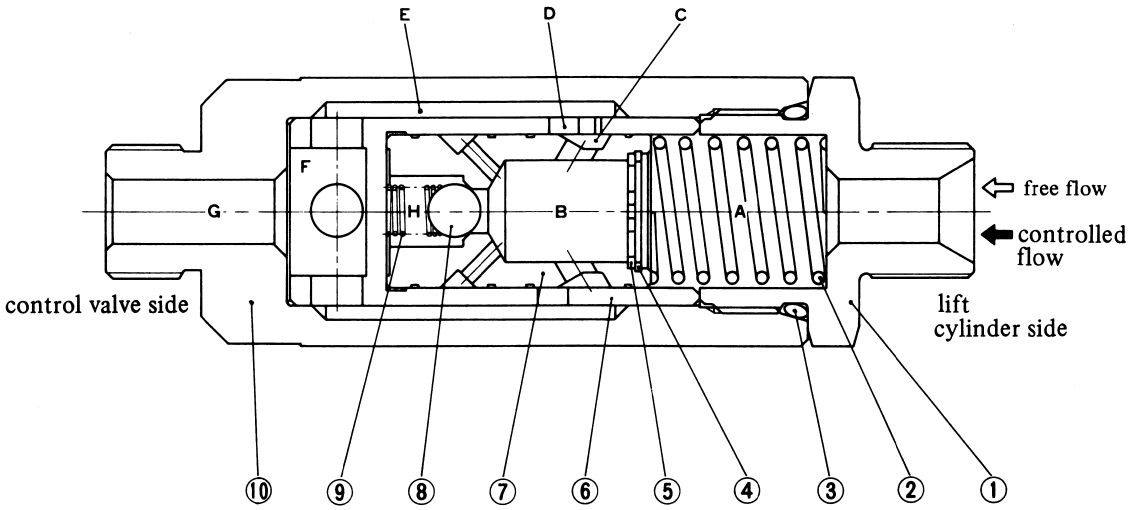


Fig. 11-20. Flow Regulator Valve

1. Nipple
2. Spring
3. "O"-ring
4. Snap ring
5. Orifice
6. Sleeve
7. Piston
8. Ball
9. Spring
10. Case

11-1-6. TILT CYLINDER

The tilt cylinder is a double-acting type, and its piston rod end is supported by the mast and the cylinder tail is connected to the frame with a pin. This truck is provided with two tilt cylinders on both sides.

The tilt cylinder assembly consists primarily of a cylinder body, cylinder cap, piston and piston rod. The piston, welded to the piston rod, has two packings and one wear ring on the circumference and moves along the inner surface of the cylinder by the force of hydraulic oil. Inside the cylinder cap are press-fitted a bushing, packing and dust seal to provide oil tightness for the piston rod and the cylinder cap, and also this bushing supports the piston rod. The cap, fitted with an O-ring on the outer periphery, is screwed into the cylinder body and fastened with a lock ring.

When the tilt lever in the driver's room is tilted forward, high-pressure oil enters the cylinder tail side, moving the piston forward. This causes the mast to tilt forward 6 degrees. When the tilt lever is tilted backward, high-pressure oil enters the cylinder cap side and moves the piston backward, tilting the mast 12 degrees backward.

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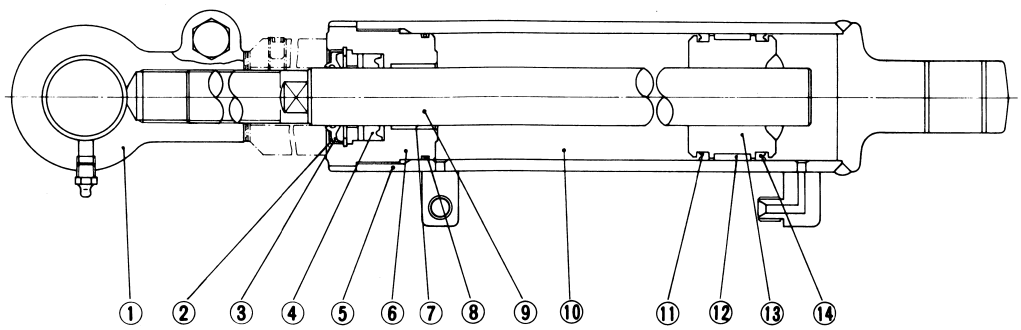


Fig. 11-21 Tilt Cylinder

1. Piston rod connecting rod
2. Snap ring
3. Dust seal
4. Oil seal
5. Lock ring
6. Cylinder cap
7. Bush
8. "O"-ring
9. Piston rod
10. Cylinder
11. Piston packing
12. Wear ring
13. Piston
14. Piston packing

11-2. MAINTENANCE

11-2-1. DISASSEMBLY (For circled numbers see Figs. 11-28 & 11-29)

(1) Before attempting to disassemble the pump, thoroughly clean it. It is good practice to put disassembled parts on a clean paper or cloth, and take care not to contaminate or damage them.

(2) Hold the pump in a vice by lightly clamping the flange section, and remove bolt ⑫.

(3) Remove cover ① and remove seal ⑧, ⑨, ⑩, and ⑪.

(4) Remove mounting flange ⑦, and remove seals ⑧, ⑨, ⑩, and ⑪.

(5) Remove bushings ③ & ④ and gears ⑤ & ⑥ from pump body ②. If it is difficult to remove the bushings, press the gears in.

(6) Do not remove oil seals ⑮ & ⑯ press-fitted into mounting flange ⑦.

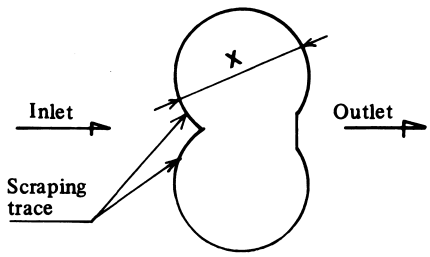
For the convenience of correct reassembly, it is recommended to put the disassembled parts as shown in Figs. 11-28 & 11-29.

11-2-2. INSPECTION AND REPAIR

After checking the disassembled parts for contamination or discoloration, wash them with light oil. However, do not wash rubber items with light oil. Proceed with the following inspections, and repair or replace, if necessary.

(1) Pump body Inspection

The gear pump is designed to allow the gear teeth to rotate, lightly touching the pump body inner surface for a good efficiency. Therefore, once used, the pump body will surely get scraping traces on or around the inlet port. The normal scraping trace is 1/3 long of the inner periphery of the pump body. If the scraping trace becomes longer 1/2 of the inner periphery, it indicates that the bearing and gear shaft are worn excessively. When size X shown in Fig. 11-22 exceeds 39.180 mm (1.55 in) or the scraping trace reaches the half of the periphery, replace the pump body.



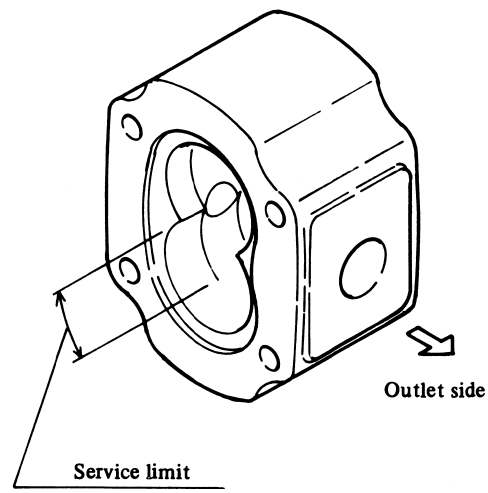


Fig. 11-22

(2) Bushing Inspection

It is desired as an ideal condition that there is no roughness on the inside sliding surface and about the half portion of the inlet side presents lustrous contact surface. And in good operating conditions, the inlet side gets a little stronger flank contact while the outlet side gets weaker one. See Fig. 11-23. If any one of the following conditions is noticed, replace the bushing.

- The whole inner sliding surface shows a sign of contact and gets so rough that your nail catches.
- The flank has much flaws in peripheral direction and gets rough to the extent that your nail catches.
- The inner sliding surface and flank have traces made by catching foreign matters.

The above troubles of the bushing in most cases result from contamination of hydraulic oil. If such a case occurs, perform flushing to the whole circuit and change oil. On rare occasions, the bushing may get troubles due to overload, cavitation or aeration caused by the defective relief valve, abnormal rise of oil temperature, contaminated oil or too low oil viscosity. If the bushing has any trouble indicated above, the gear shaft and flank also may be rough or worn excessively. Replace the gear as well as the bushing. The service limit of the bushing is as follows:

Inner diameter: 19.123 mm (0.753 in)

Overall length: 26.411 mm (1.04 in)

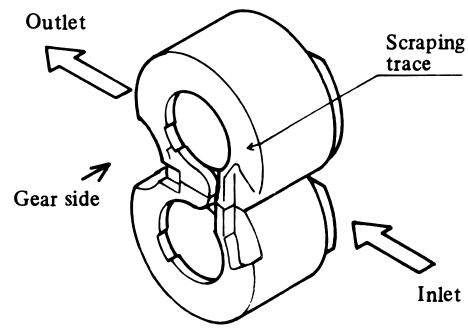


Fig. 11-23

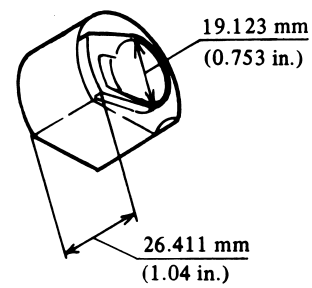


Fig. 11-24

(3) Gear Inspection

As long as clean hydraulic oil is used, the shaft and gear flank will not get damaged, showing a sign of smooth contact. If the shaft and gear flank is rough to the extent that your nail catches when scratching, or if the gear tooth flank is cracked or the tooth surface is excessively worn unevenly, replace the gear with new one. When the gear surface is worn or discolored, it indicates that the bushing and pump body also get any trouble.

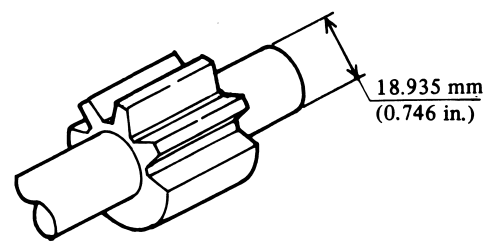


Fig. 11-25

Inspect again the bushing and pump body. The gear shaft diameter limit size is 18.935 mm (0.746 in).

(4) Seal Inspection

(a) Oil Seal ⑮ (See Fig. 11-26.)
This pump has an oil seal that provides oil tightness by the inner side seal lip and prevents enterance of dirt and air by the outer side dust lip. Inspect the seal especially for flaw, wear or deformation and also check to see that the rubber has sufficient elasticity. If any defect is noticed, replace with new one.

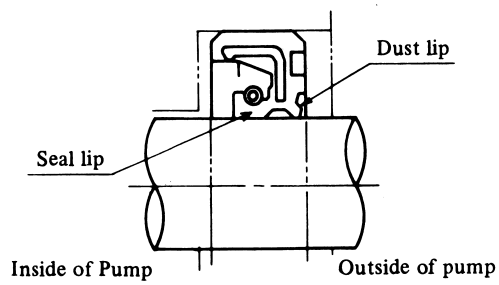


Fig. 11-26

(b) Seals ⑧ & ⑨
Pump body seal ⑧ and bushing seal ⑨ should be replaced with new ones when reassembling the pump body.

(c) Packing Ring ⑩ & ⑪.
Check for fray or breakage.

11-2-3. REASSEMBLY

(1) Clean all disassembled parts.

(2) Apply a thin coat of clean grease on the lips of seals ⑧, ⑨, ⑩, ⑪, and oil seal ⑮.

(3) Put pump body ② on a plain stand with cover ① upward. Apply a thin coat of clean hydraulic oil on the inner surface of the pump body.

(4) Put cover side bushings ③ and ④ together in the pump body. Care should be taken not to have the wrong combination. Install the bushings, matching each other correctly. If they are difficult to settle, pull them out and try again. Do not tap or press by force.

(5) Turn the pump body over. Put drive gear ⑤ and driven gear ⑥ in the pump body so that the same teeth that was in mesh before disassembly may be engaged.

(6) Using the same procedure as Step (4), install bushings ③ and ④ of the mounting flange ⑦ side.

(7) Install bushing seal ⑨, pump body seal ⑧, and packing rings ⑩ & ⑪ in this order. Be careful not to overlap the packing at the center.

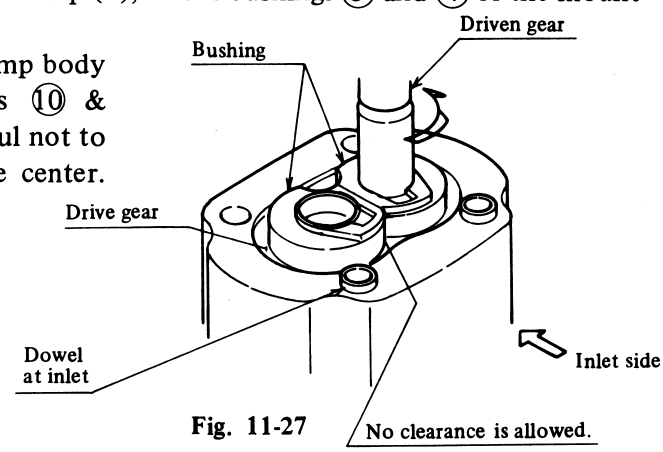


Fig. 11-27

11-2-4. FLOW PRIORITY VALVE

(1) Disassembly

(a) Loosen the plug (7) by two or three turns and remove the connector (6) from the housing (1).
Note: Do not remove the plug (7) at this stage. The spool (2) may drop on the land of the housing (1) at the moment the connector leaves off the housing, so that the land may be damaged by the spring (3).
(b) Remove the plug (7) from the housing.
(c) Holding the sleeve (4), install a bolt into the threaded area of the end of the spool (2) and remove the sleeve (4).
(d) Remove the spool (2) slowly. Care should be exercised so as not to allow it to drop on the land of the housing (1).
(e) The ring (3) comes out along with the spool (2).
(f) Remove the connector (6-1) and plug (6-3) from the connector (6) along with the ball (6-2)
(g) Do not remove the snap ring (5) from the sleeve (4); otherwise it may get deformed.
(h) Remove the "O"-rings from the plugs (7, 6-3) and connector (6-1).

(2) Reassembly

After disassembly, clean all parts in clean mineral oil. Inspect each part for burrs, scratches or other defects. Due attention should be paid to the sliding area of the housing (1) and diameter of the spool (2). All "O"-rings should be replaced with new ones.

(a) Apply a good quality grease on new "O"-rings and intall them on the respective positions.
(b) Install the sleeve (4) with the snap ring (5) on the housing (1).
(c) Install a bolt into the treaded area in the spool (2) and attach the spring (3). Install the spool (2) and spring (3) into the housing (1) carefully.
(d) Push in the spool (2) slightly, and the sleeve (4) will project at the opposite side of the housing (1). Holding both ends of the spool (2) and sleeve (4) with your fingers, check to see if the spool (2) moves smoothly.
(e) Screw in the plug (7) by two or three turns so as not to allow the spool (2) to drop on the land of the housing (1) and install the connector (6) from the opposite side. (The connector (6) should be reassembled in the sequence opposite to disassembly.)
(f) Tighten the plugs (7, 6-3) and connector (6-1) to the specified torque.

11-2-5. RELIEF VALVE

(1) Reassembly

(a) Loosen the plug (13) and remove it from the housing (1).
Note: Do not loosen the lock nut unnecessarily; otherwise the relief pressure may vary. If the lock nut is loosened, be sure to check relief pressure by means of a pressure gauge thereafter.

(b) Hold the convex part of the housing (11) in the round pliers and remove the housing (11) from the housing (1).
(c) The poppet (10) comes out along with the housing (11).
(d) Put the housing (11) vertical and remove the spring (9).
(e) Remove the "O"-ring from the housing (11).

(3) Reassembly

For the procedure of cleaning for parts and replacement of "O"-ring, refer to "1-2". Visually check the seats of the housing (11) and poppet (10) for any sign of defect. Reassembly should be performed in the sequence opposite to disassembly.

11-2-6. ADJUSTMENT OF RELIEF VALVE

(1) Main Relief Valve

(a) Install a pressure gauge on the outlet section gauge port (PT1/4).
(b) Loosen the lock nut of the relief valve and turn loose the adjuster by 1/4 or 1/2 of a turn.
(c) Start the engine. Actuate the tilt cylinders to their stroke end and read the pressure gauge.
(d) When the reading is not as specified, obtain the specified value by turning the adjuster.
(e) Loosen the lock nut and recheck the pressure.
(f) Remove the pressure gauge.

Main Relief Pressure : 175 kg/cm^2

(2) PS Relief Valve

(a) Install a pressure gauge on the outlet section PS gauge port (PT1/4).
(b) Loosen the lock nut of the PS relief valve and turn loose the adjuster by 1/4 or 1/2 or a turn.
(c) Start the engine. Turn the steering wheel as far as possible in either direction and read the pressure gauge.
(d) When the reading is not as specified, obtain the specified value by turning the adjuster.
(e) Loosen the lock nut and recheck the pressure.
(f) Remove the pressure gauge.

PS Relief Pressure: 90 kg/cm^2 (2.0 – 2.5 ton)
70 kg/cm^2 (2.8 – 3.0 ton)

11-2-7. TROUBLESHOOTING

If any trouble is found with the flow priority valve, take necessary measures according to the table given below.

(1) Flow priority valve

Problem	Cause	Remedy
PF circuit pressure does not increase Specified flow rate not obtained	Spool sticking	Disassemble and clean.
	Defective sliding surface	Replace spool.
	Broken spring	Replace spring.
	Clogged orifice	Disassemble and clean.
	Maladjustment of relief valve	Readjust relief valve.
EF circuit pressure dose not increase	Spool sticking	Disassemble and clean.
	Clogged orifice	Disassemble and clean.
Vibration Slow pressure rise	Spool sticking	Disassemble and clean.
	Insufficient air bleeding	Bleed air sufficiently.
PF circuit pressure higher than pressure setting Specified flow rate not obtained	Spool sticking	Disassemble and clean.
	Clogged orifice	Disassemble and clean.
	Relief valve malfunctioning	Readjust.
Noisy operation	Relief valve malfunctioning	Readjust.
	Sliding area worn	Replace relief valve.
Oil leak (external)	"O"-ring deteriorated or damaged	Replace "O"-ring.
Low pressure setting	Spring defective	Replace spring.
	Seat surface defective	Readjust or replace relief valve.
Oil leak (internal)	Seat surface damaged	Correct seat surface.
High pressure setting	Poppet sticking	Disassemble and clean.

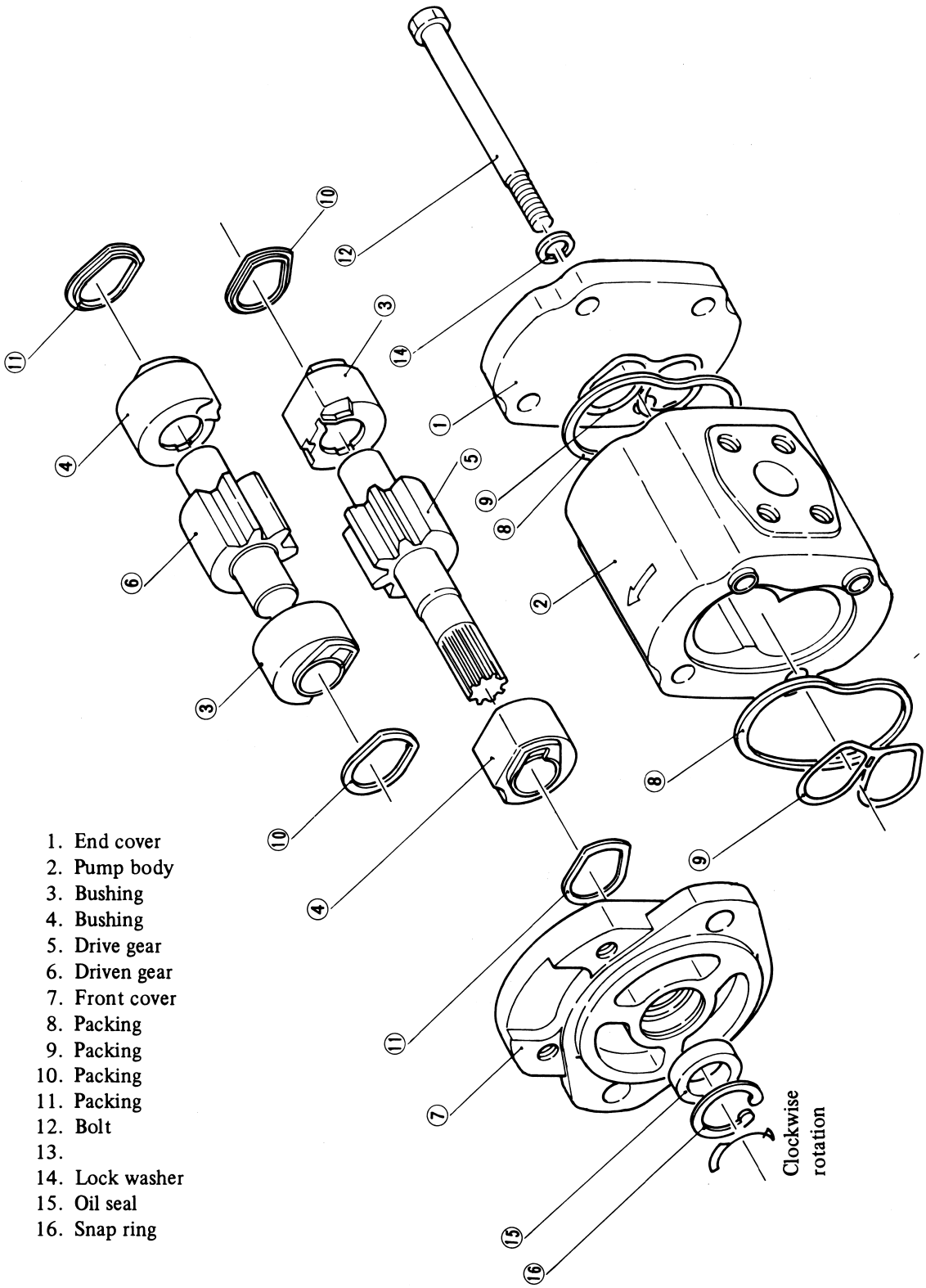


Fig. 11-28. Clockwise Rotation Type Gear Pump (for Gas. type truck)

1. End cover
2. Pump body
3. Bushing
4. Bushing
5. Drive gear
6. Driven gear
7. Front cover
8. Packing
9. Packing
10. Packing
11. Packing
12. Bolt
13.
14. Lock washer
15. Oil seal
16. Snap ring

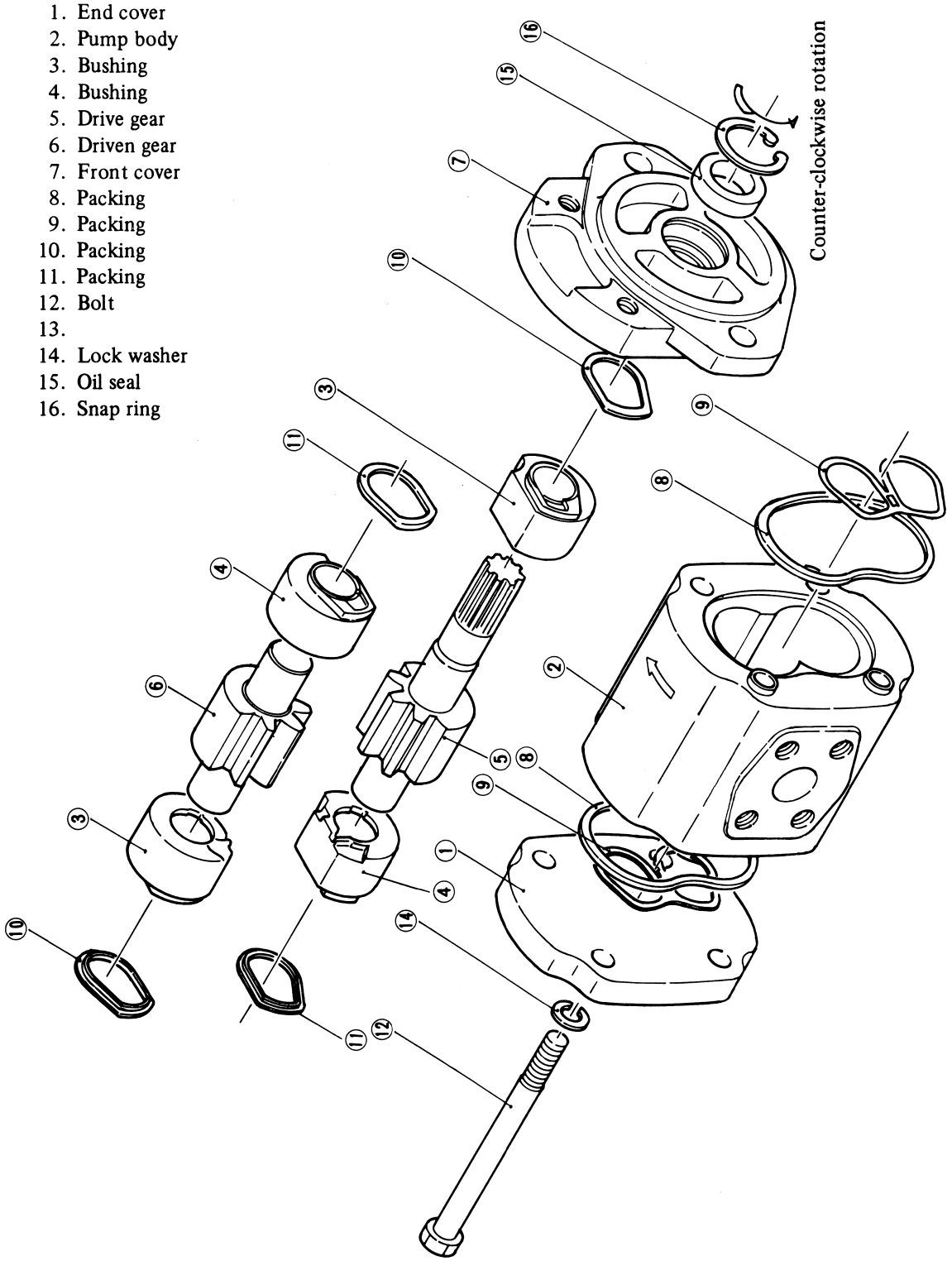


Fig. 11-29. Anticlockwise Rotation Type Gear Pump (for Diesel type truck)

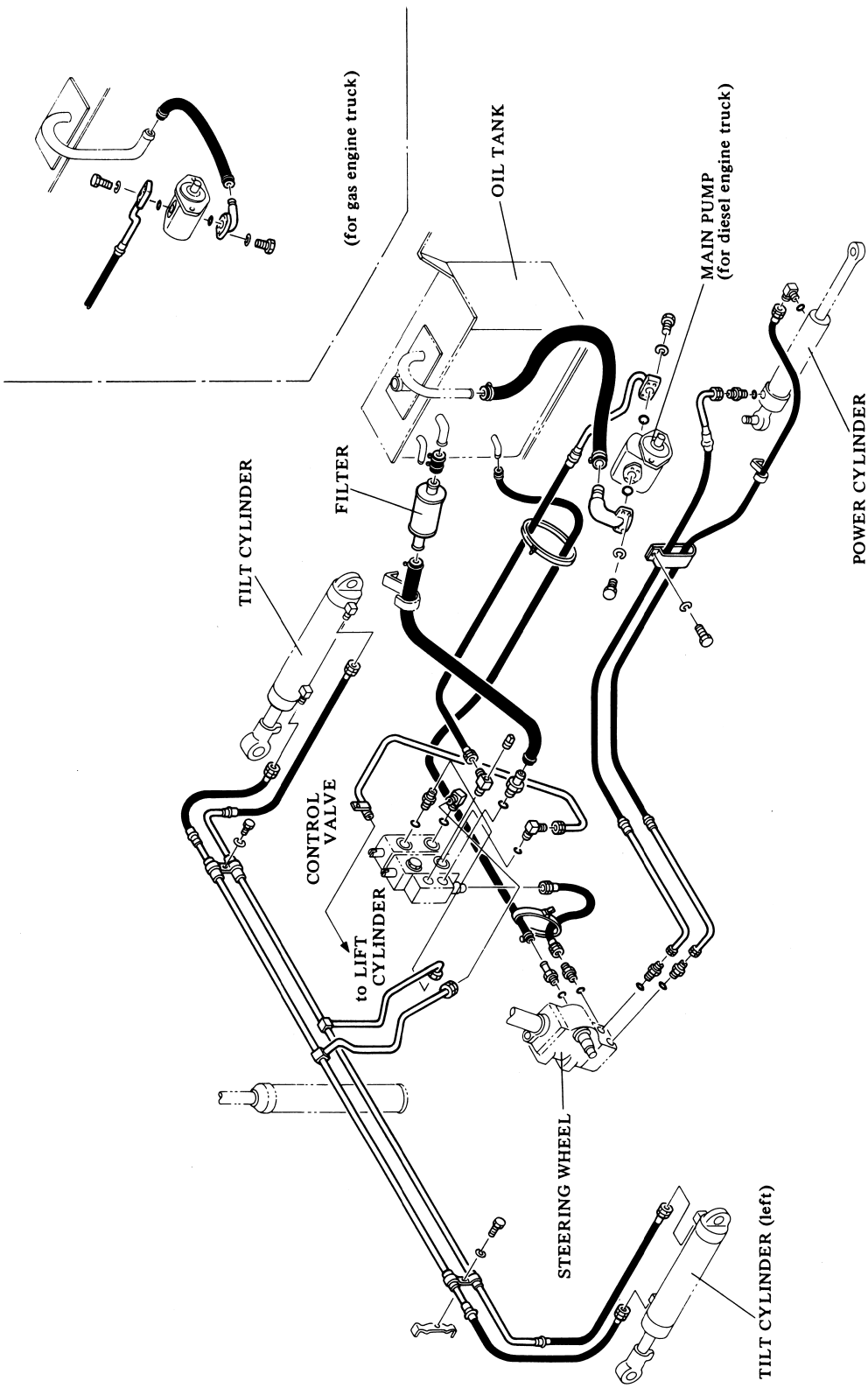
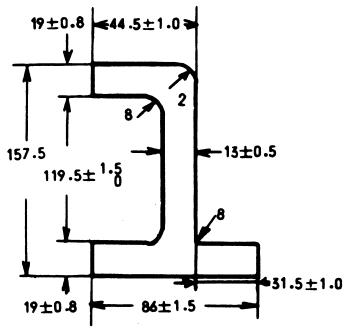
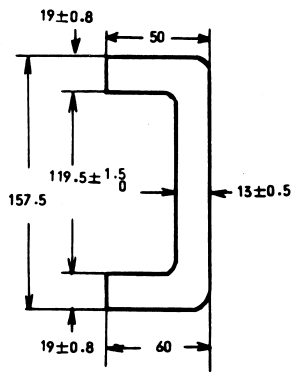


Fig. 11-30 Hydraulic Piping

12. LOADING SYSTEM

Type:	Rolling type, J-shaped inner mast and ⊐-Shape Outer mast, 2-step telescopic mast with free lift
Cross section of inner mast:	
Cross section of outer mast:	
O.D. of end roller:	119.5 mm [119 mm] (4.7 in (4.69 in))
O.D. of side roller:	58 mm (2.28 in)
O.D. of retaining roller:	80 mm (3.15 in)
O.D. of rear end roller:	80 mm (3.15 in)
Lift chain:	JIS roller chain 2 lines
Fork lifting system:	Hydraulic
Mast tilting system:	Hydraulic
Fork interval adjusting system:	Manual
Weight [mast, lift bracket and finger bar]:	490 kg (1080.5 lbs)

12-1 GENERAL DESCRIPTION

The hoist system is of the two-stage, rolling telescopic mast type. The outer mast has ⊐ shaped section and the inner mast has J-shaped section. The finger bar meets the ITA Standard. The two-stage operation contains a free lift range.

12-1-1 OUTER & INNER MAST

The mast assembly is of the free lift range-contained two stage telescopic type consisting of the inner and outer mast, and sustained by mast supports which are welded to the bottom of the outer mast, being extended from the axle housing. The outer masts are provided with brackets holding lock pins for tilt cylinder connecting hardware. The mast is tilted by operation of the tilt cylinders, forward 6° and backward 12°.

The inner mast is composed of right and left mast frames which are connected with each other by upper and lower connecting members. At the upper inside of each outer mast frame an end roller is installed on the end roller shaft welded to the frame, with a snap ring. In addition, the outer mast frames are fitted with side rollers to sustain the inner mast frames. At the lower outside of each inner mast frame an end roller is installed on the end roller shaft with snap ring, which is welded to the inner mast. Under the end rollers other side rollers are located to sustain transverse load. With the aid of these rollers, the inner mast can smoothly operate.

12-1-2 CARRIAGE

At the carriage, end rollers that roll along the inside of the inner mast frames are installed on the end roller shafts with snap rings. The end roller shafts are welded to the carriage. The side rollers that roll along on the inside of the inner mast frames are bolt fitted, being shim adjusted. To prevent the rolling of the finger bar, two retaining rollers are used, which roll along on the outside of inner mast frames. The longitudinal load is sustained by the end rollers of which the upper one emerges from the mast top when the forks reach the maximum lift height. The transverse load is sustained by both upper retaining rollers and lower side rollers. As we mentioned above, the mast assembly and carriage are designed with rigidity, stability and smooth operation in mind.

Furthermore, the finger bar and carriage are made into one body construction using high tension steel to improve the durability. This meets the ITA Standards.

The two forks installed on the finger bar are made of special alloy steel which has been subjected to heat treatment.

12-1-3 MAST ADJUSTMENT

(1) **Finger bar position**

Put the mast frames vertical and lower the forks on the ground. Adjust the parts (a) of the tilt cylinders so that each end roller overlaps the mast fins by 15 to 20 mm (0.59-0.79 in).

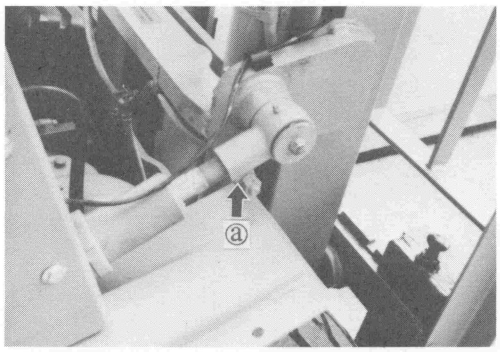


Fig. 12-1.

(2) **Lift chain tension**

Tilt back the mast fully and adjust the lift chains so that both chains have even tension at the points (b).

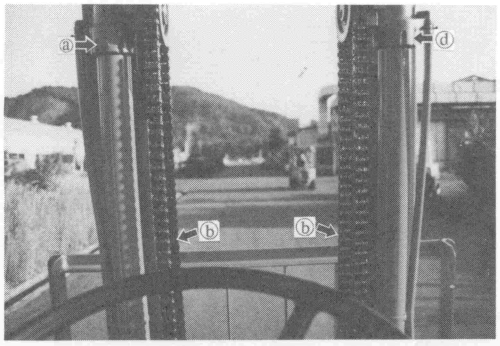


Fig. 12-2.

(3) **Piston head angle**

Raise the forks up to the highest position within the free lift range. Adjust the adjustor at the top right of the piston head guide to secure even tension of the lift chains.

(4) **Lift cylinder stroke**

Lift the forks up to the highest position and adjust the lift cylinder stroke by turning the cylinder caps (d) so that there is no deflection on both mast frames.

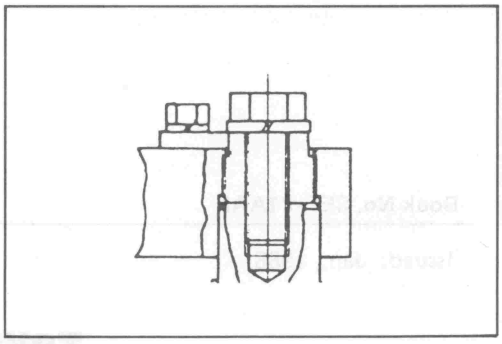


Fig. 12-3.

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